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ABSTRACT

This curriculum guide was designed to give teachers, students, and society a better understanding of wetlands in the hope that they learn why wetlands should be valued and preserved. It explores what is meant by wetlands, functions and values of wetlands, wetland activities, and wetland offerings which benefit animal and plant life, recreation, the environment, and humans. Sections include: (1) What is a Wetland?; (2) How Wet is a Wetland? The Importance of Water; (3) The Power of Wetland Plants; (4) What's the Muck on Wetland Soils?; (5) Why are Wetlands Important?; (6) Come For Just a Visit--Or Stay for a Lifetime; (7) Get To Know Your Wetland; and (8) Wrapping it Up. Includes a glossary and an index. (JRH)

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King County Parks

Wonderful Wetlands

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An Environmental Education Curriculum Guide For Wetlands

Produced by King County Parks Division in cooperation with REI

SP05 782

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Introduction

The term wetland now encompass's all land that is flooded or wet during part of the year. It was not long ago when we were unable to "see" wetlands. It was not that they did not exist in our environment, but sadly we just did not "see" them. This blindness was the result of the lack of understanding and lack of recognition of natures's true beauty. Through education — learning, exploring, sharing, and teaching — that wetlands will always be valued and "seen".

Salt marshes, marshes, swamps, bogs, fens, flats, moors, are uniquely different from one another, yet they are all wetlands. Wetlands are present in every state in the nation and there are thousands of wetlands in the state of Washington. Although that may seem like plenty, it is not. The Washington State Department of Ecology, who considers wetlands to be the most productive ecosystems on earth, states that wetlands values have been misunderstood.

Fifty-three percent of the wetlands in the contiguous forty eight United States were lost between the late 1700's and mid 1970's. Twenty-three states have lost 50% of their original wetlands and seven of those twenty-three states have lost more than 80% of their original wetlands. From the mid 1970's to the mid 1980's wetlands were lost at an annual rate of 290,000 acres per year.

Washington state is losing 2000 acres of wetlands a year. Fifty percent of the state's wetlands have been lost to developmental and agricultural use. Draining, filling, polluting, eliminating buffers, noxious invasive plant species, and other destructive actions by humans have led to the elimination of many wetlands. This elimination has caused increases in flooding, water pollution, property damage, and losses of wildlife and habitat. We now realize that not only does the majority of wildlife and various plants depend on wetlands, but WE depend on wetlands!

How To Use This Guide

There are several purposes and goals of this curriculum guide on wetlands. It is our hope that as teachers, students and society gain a better understanding of wetlands they will learn why they should be valued and preserved. In this curriculum guide teachers and students will explore what is meant by "wet lands". Then functions and values of wetlands will be considered. Wetland activities for the areas of study will be intermixed. Through continuous education we will be able to learn about more of the wetlands' offerings which will benefit animal and plant life, recreation, the environment as well as humans.

King County Parks Divisions Countywide Office offers in classroom and field studies in wetlands and on Puget Sound, as well as teachers workshops and family interpretive walks. For more information call (206)296-4171.

IMPORTANT NOTES

What Is A Wetland?

Notes...

Let's Begin With What Is A Watershed?

A watershed is a region of land draining into a river or body of water.

If the body of water is large, like the Cedar, Green or Snoqualmie Rivers, its watershed area is huge. If the body of water is small, like Bear or Mill Creek, the watershed is much smaller. What is a watershed? A watershed has "walls of hills and mountains; a floor of a river or lake; and a roof of rain clouds", said author Peter Marshall

The rivers, hills and bottom lands are all part of the system. Every activity on land, in water or even in the air can affect the watershed system.

Watershed Activity

OBJECTIVE

1. Students will be able to define and/or give an example of a watershed.
2. Students will be able to list two effects of poor watershed management (e.g. poor water quality (pollution) and flooding).
3. Students will be able to identify three characteristics of watersheds in good and poor condition.
4. Students will be able to suggest three ways of improving water quality of a watershed.

MATERIALS

paper

pencils

map of your local watershed

map of school grounds

PROCEDURE

1. Through class discussion arrive at an understandable definition of "watershed". A watershed, or drainage basin, is an area of land from which a stream, river or another body of water gets its supply of water. The watershed may be as small as a farm or as large as several states. It is a natural basin or area where water is naturally stored for later distribution through a river or stream or groundwater system.

Notes...

2. Calculate the area of land covered by the buildings and pavement on the school site. Determine the amount of water run-off from these areas during a hypothetical 4-inch rain. Where will this water go? Where would it go if the building and pavement were not there? Discuss with the class the effects of this run-off on the groundwater table and sewage treatment systems. What other facilities in the community are covered with large areas of building and paving? (e.g. shopping centers, downtown business area, etc.). Speculate with the class as to the total impact on the water table and sewage treatment systems caused by all this covered area. Discuss ways to rectify or at least minimize the negative effects. Emphasize that these areas are part of a watershed. Introduce the term *impervious surface.*

3. Discuss the entire watershed of your area. What does it include? Farm land, grassland, forested areas? What is the importance of vegetation on the watershed? What would happen if the vegetation was removed? What kinds of use or misuse can cause the loss of vegetative cover? (Poor farming practices; overgrazing; deforestation by fire or excessive timber harvesting.)

4. Using a watershed map, have students answer the following questions: What watershed do you live on? When water runs from your roof, where does it go? When you turn on your faucet where does the water come from?

Let's Define Wetlands

Where do you go to hear frogs croak, to watch herons fish, and to feel fuzzy cattails? To wetlands, of course! Wetlands are unique areas with a personality all their own that change from season to season. Thousands of plants and animal species call wetlands their home or a nice place to visit over winter. Wetlands are found all over the world where low lying lands meet water or rivers meet oceans.

There are many ways to define a wetland. The most common definition was developed by the United States Fish and Wildlife Service. A wetland is land that has three characteristics:

1. **It is covered by water** or has waterlogged soil for at least seven days during the growing season. Waterlogged soil is soil that contains so much water that there in no room for oxygen.
2. **Is the plant life.** Special plants have adapted to life in wetlands, and are called *hydrophytes* which grow without much oxygen from the hydric soil. These plants take oxygen from air or water. Cattails, lillypads and sawgrass are hydrophytes. Many areas don't have all the characteristics, or the characteristics may vary, but are still wetlands (ie. they may be wet only seven days of the year.) Today, scientists use sophisticated equipment to classify wetlands.
3. **The soil is hydric soil.** Most soil contains plenty of oxygen for plants and trees to use as energy and food to grow. *Hydric* soil is mostly *anaerobic* which means that it does not have enough oxygen for upland plants to grow, such as Douglas fir and madrona trees.

How Are Wetlands Created?

Wetlands are created by natural causes or they can be artifically created. Most wetlands were created naturally. Throughout history, glaciers have moved over the earth many times. As glaciers moved across the land, they carved depressions in the ground. When the glaciers melted, the oceans overflowed creating salt water marshes. Melted glaciers and rain created different wetlands. Wetlands can also be created by beavers building dams, rivers changing their course, volcanic activity, or by the process called succession. *Succession* is the natural process by which one kind of vegetation replaces another. An example of succession would be as dead plants and leaves pile up on the bottom of a lake, the decaying vegetation would slowly replace the water in the lake. Eventually, this lake would become a bog.

Sometimes a wetland is created by human intervention, a dam is built or construction reroutes a stream. However, true biologically functioning wetlands can not be made by humans. Research is currently being conducted to learn ways to restore wetlands, but wetland restoration and revegetation are not the total solution.

Notes...

Notes...

Down by the Bay - Activity

OBJECTIVE

Students will learn how humans have interacted with wetlands throughout the history of the Pacific Northwest.

METHODS

Students will perform a choral reading and create a way to illustrate each stanza either through drama, art or music.

TEACHER BACKGROUND

Throughout history, people have failed to find value in wetlands and have degraded and destroyed them for a number of reasons. Early European settlers came to the Pacific Northwest and found rich and fertile agricultural land for their crops. Wetlands, worthless in the settlers' eyes, were readily converted for farm land by digging canals and draining the land. Once thriving wetlands became crop lands, hayfields, cow pastures, and orchards. With the rapid population growth in the 1900's, wetlands, especially salt marshes, were filled to provide more space for manufacturing. Some wetlands were dredged to provide more space for manufacturing. Some wetlands were dredged to provide deeper harbors for shipping. Additional losses resulted from residential and commercial development and road construction.

Wetland losses are by no means limited to the Pacific Northwest. Over half of the wetlands that once existed in the continental United States have been destroyed. Losses continue at an estimated rate of 300,000 to 500,000 acres per year.

MATERIALS

"Down by the Bay," a choral reading, art materials and/or rhythm instruments.

PROCEDURES

1. Assign parts of the choral reading, "Down by the Bay", to different groups of students. The following suggestion represents only one way in which the parts could be divided:

   Lines 1-8: All read

   Lines 8-16: Girls read

   Lines 17-24: Boys read

   Lines 25-32: All read

   Lines 33-64: Each line read by a different individual

   Lines 64-72: All read

2. Discuss the history of human interaction with wetlands. What are some of the things people have done to wetlands and why:

Notes...

GRADE LEVEL VARIATIONS
K-3

Make several class books of "Down by the Bay", each page having half a stanza written and illustrated by students or pairs of students. Send a book home each night with a different student to share with his/her family.

EXTENSIONS
Choose a creative way for students to illustrate/perform this choral reading. Suggestions include:

- Making a mural showing a timeline from 1800 to the present. Along the timeline, have students record the nine stanzas from the choral reading and illustrate each one.
- Dividing the class into nine groups and assign each group a stanza. Have each group create a way to present their stanza through choral reading and the use of rhythm instruments (or other sound effects). Tape record each group in sequence.

EVALUATION
Have students describe three ways in which humans have harmed wetlands over the years.

Notes...

Down By The Bay

By Susan Vanderburg

Long ago, on a quiet bay,
An Indian family decided to stay.
They built their homes from cedar trees.
For their food, they turned to the seas.
They gathered clams and mussels too,
But never more than they could use.
Salmon fed them all year long,
And they offered thanks in prayer and song.

One day a giant ship appeared.
To the men on board, one thing was clear.
This bountiful land, there was no mistaking,
Had wood, and furs, and fish for the taking.
Before long, more white people came,
Built trading posts, and hunted game.
More ships now came into the bay,
And some of the animals moved away.

Next settlers came from over the land,
With wagons and seeds and dreams and plans.
They built their farms and soon say how
The rich, flat marsh could easily be plowed.
To keep the sea away from the crops,
The farmers built walls of heavy rocks.
They diked off part of the beautiful bay,
And many more animals moved away.

More settlers came and wanted a town,
But the shore by the bay was soggy ground.
The marshland looked like a muddy place,
A grassy place just going to waste.
So they filled it with dirt and build wide piers.
They dredged out the harbor so ships could come nearer.
The dredgings were piled on the shores on the bay,
And many more animals moved away.

People made money by logging trees.
Logs could float down the river with ease.
Soon, the mouth of the river was filled
With logs awaiting their turn at the mill.

The saw blades screamed; the wood chips flew.
Wagons carried lumber, and ships did too.
The chips and bark settled into the bay,
Many animals wished they could move away.

Now the town has grown to a city,
The noise and the garbage aren't very pretty.
Canneries border one stretch of shore.
They process fish for the local stores.
A marina was built for pleasure boats.
On the water more gas and oil floats.
Factories dump waste-water into the bay,
And not many animals care to stay.

People have always looked at the bay
And thought, "What a great place for humans to stay."
They used the bay to meet their needs,
(Or in some cases, to satisfy greeds.)
They didn't know that the bay, left alone,
Was a valuable place, all on its own.
"What good is a muddy old bay", you might say?
Just look what a marshland can give us each day!

For migrating birds, a resting ground,
A more suitable place could hardly be found.
For young salmon coming down from a stream,
A place to feed and get used to the sea.
For baby animals of every kind,
A better nursery would be hard to find.
The marsh is a natural filter too,
Trapping pollutants that enter the slough.

For living things, a salt marsh can yield
More food than produced in a farmer's field.
The marshland food-chains even included
Humans who harvest the bay's rich food.
Next time you gaze at a grassy bay,
Remember the poem you heard today.
Remember the value of this special place,
To all creatures, including the human race.

Source: Department of Ecology, Second Edition, Discover Wetlands.

Notes...

Notes...

Wetland Similes - Activity

OBJECTIVE

Students will be able to create and use similes to help them to understand the basic functions and values of a wetland.

METHODS

Students use comparison with familiar objects to understand how a wetland functions.

TEACHER BACKGROUND

Wetlands perform a number of natural functions with great benefit to people. The functions depend on the wetlands location, surrounding topography, sub-surface geology, hydrology, and the types of plants present. While each wetland may not perform all functions, the cumulative value of all the wetlands in a watershed makes each important. The major functions of wetlands are as follows:

(1) Wildlife habitat

(2) Flood control and groundwater recharge

(3) Water filtration and purification

(4) Shoreline anchoring and erosion control

(5) Human recreation and education

MATERIALS

Bag containing a sponge, pillow, egg beater, cradle, strainer or filter, can of soup, toy boat, shin-guard (or a door stop), book; Video: "Fabulous Wetlands"

PROCEDURES

1. Bring out the bag containing the objects listed under "Materials." Explain that a simile is used as a means of comparing things that are essentially unalike and the comparison is expressed by the use of some word or phrases, such as "*like, as, than, similar to, resembles,* or *seems.*" Give examples: "The moon is *like* a brilliant pearl in the sky." "The pen is mightier *than* the sword." "The students sat as orderly *as* frozen fish in a package."

2. Then take one object at a time out of the bag and have students explain how each item is like a wetland. The following are some likely explanations:

- A wetland is like a sponge because it soaks water and prevents flooding.
- A wetland is like a pillow because it's a resting place for migrating birds and salmon.
- A wetland is like an egg beater because salt water and fresh water get "mixed" in some wetlands.
- A wetland is like a cradle because so many animals use wetlands for nurseries.
- A wetland is like a strainer because the plants filter out sediments and pollution.
- A wetland is like a can of soup because it provide so much food for wildlife and humans.
- A wetland is like a boat because there are a lot of recreational opportunities in a wetland.
- A wetland is like a shin-guard because it protects the shore from erosion.
- A wetland is like a book because people can learn so much from it.

3. Have students work in pairs or groups to brainstorm more similes. Encourage them to look around the room and think of everyday objects. "A wetland is like a pair of sunglasses because it keeps the water shaded and cool in places." "A wetland is like a dollar bill because it is valuable." Have groups share their ideas with the rest of the class.

Notes...

GRADE LEVEL VARIATIONS

This lesson can be easily adapted for all grade levels K-12.

EXTENSIONS

Have each student create a page for a class book, with each page illustrating a different wetlands simile. Share the book with other classes or have students rotate the book home to share with their families.

View the video "Fabulous Wetlands". Discuss which information was a review for students and which information was new. You may want to view the video again (it's very fast-paced) and discuss which additional information the students gained the second time.

EVALUATION

Have students complete wetlands simile sentences such as: "A wetland is like a sponge because....."

Source: Wetlands of the Pacific Northwest

Notes...

Many Types Of Wetlands

Forested wetlands are covered mostly with trees 20 feet or more in height. They may be *evergreen* or *deciduous.*

Bogs are an interesting type of forested wetland. Bogs are usually located in holes carved by glaciers, in which water has been trapped. Because the water in a bog is acidic and has little oxygen, very few plants live there. Without decomposing bacteria, dead plants may lie in a bog for thousands of years witout decaying and turning back into soil. The floating mat of rotting plants is called *peat.* It can take up to 100 years for one inch of peat to accumulate. Peat is full of holes that suck up water like a sponge, making the ground squishy and wet. You may think the small trees growing in a bog are young but they can be 100 or 200 years old. The cranberries you may eat for Thanksgiving grow in bogs. Bogs often contain other plants like bog laurel, Labrador tea and insect eating plants such as the pitcher plant and sundew.

Forested wetlands are valuable breeding areas for black ducks, wood ducks and other waterfowl. Forested wetlands also provide homes for deer, raccoon, opossum, cottontail rabbit, ruffed grouse, and birds such as warbler, flycatcher, woodpecker, nuthatch, grosbeak, hawk and owl.

Scrub/Shrub wetlands have mostly small trees and bushes less than 20 feet in height. They are found in areas where the water is close to the surface and next to rivers, lakes and streams. Willows, red osier dogwood, spirea, red-flowering currant and Indian plum are common plants in scrub/shrub wetlands.

Shrub wetlands offer habitat for game birds such as ring-necked pheasants. Herons and kingfishers hunt in shrub wetlands and mammals such as muskrats, cottontail rabbits, and deer call it home. Open water invites wood ducks and song birds.

Emergent wetlands are dominated by 'sway in the wind' grassy plants. They are often next to major lakes and streams. Wetlands dominated by soft-stemmed plants like: cattail, bulrush and reed canary grass are generally called *marshes. Fens* (often mistakenly called bogs) also grow on peat. Fens, unlike bogs, have slow moving water which rinses out the acid created by peat and mosses. Because fens aren't acidic, they are home to many kinds of plants that can't survive in bogs such as sedges, grasses, willows, dwarf birches, and even cattails. Certain seasonally-flooded wetlands are called *meadows.*

Wildlife need emergent wetlands for homes. As waterfowl habitat, emergent wetlands are used for mating, nesting and broodrearing. During migration, they are used for resting and feeding. Ducks, geese, rails, red-winged

blackbirds, marsh wrens and wading birds such as herons and bitterns are found in emergent wetlands. By watching quietly, you might see muskrats, raccoons, minks, cottontail rabbits or deer moving about the marsh.

The absence of trees or shrubs in emergent wetlands is due to frequent flooding, particularly along large rivers and streams.

Aquatic Beds are deep water places with plants that grow underwater, float on top or have floating leaves. Aquatic beds are sheltered quiet places, found near the edges of lakes or streams. The water is from three to six feet deep. This is the neighborhood of the waterlily, duckweed, pondweed and water parsley.

Aquatic beds are the feeding and resting areas for waterfowl and *spawning* grounds and feeding areas for fish.

Wetlands are unique because of water, their specially adapted plants, and soil. The next section will cover the importance of water.

Notes...

How Wet Is A Wetland: The Importance of Water

Notes...

Where Does The Water Come From?

Remember one of the three characteristics of wetlands is water. Wetlands are either covered by water or has waterlogged soil for at least seven days during the growing season.

The water in a wetland usually comes from groundwater and surface water. *Groundwater* is water that infiltrates the soil and is stored in slowly flowing and slowly renewed underground reservoirs called *aquifers*. A wetland can form on a hillside where the groundwater is seeping to the surface. Other wetlands might form in low areas where the groundwater or *water table* is at or near the surface of the earth. The saturated soil provides the kind of environment a wetland needs in order to form. *Surfacewater* is water from rain or melting snow that runs across the surface of the earth. Surface water can be in the form of a stream, river, ocean or even as water flowing across a parking lot after a good storm. Water will always run downhill. A wetland may form where the water finds a low spot to settle.

Notes...

Groundwater Recharge

Our groundwater and aquifers are replenished or recharged by rain water and melting snow that seeps into the ground. Fast moving water doesn't have as much of a chance to soak down into the ground as standing or slow moving water. A wetland, with its dense plant growth, slows the water and holds it like a sponge. The wetland slowly releases the water into the ground, replenishing water for stream, rivers and lakes for irrigation and drinking water.

Water Tripping - Activity

OBJECTIVE

To have students think through how people use water. To determine that water is essential to everyday living and that water is a part of the standard of living to which we are accustomed in our society. Students are given a limited amount of tickets with which to "buy" their water for several days. This leads to serious thought about water use and water conservation.

MATERIALS

water tickets (30 for each student)

envelopes

central collection box

BACKGROUND

On average, the human body requires about 2.5 quarts (2.4 liters) of water per day. But we use a lot more water than is needed internally. Below are some estimates of daily household water use for an American family.

Using the figure of 23 gallons (87 liters) per person per day, we use about 37 times more water than the body needs to survive. Some of this goes into activities like food preparation and hygiene, but how much water is wasted by one's lifecycle?

Compare the following domestic use per capita figures for an "average" family:

India: 6.75 gallons/day

Nigeria: 32.4 gallons/day

USA: 92 gallons/day

These figures demonstrate that lifestyle, availability of technology, and availability of water all affect the consumption rate of water.

Amount of Water used Per Day Per Four-Person Household in the U.S.

Use	gallons	liters
toilet	25	95
shower	28	106
washing dishes	15	57
laundry	18	68
lavatory	3	11
basic needs	3	11
total	**92**	**348**

Notes...

Activity Source: Adapted with permission from A Sense of Water, Southern Arizona Water Resources Association, Inc., Tucson, AZ, 1984.

PROCEDURES

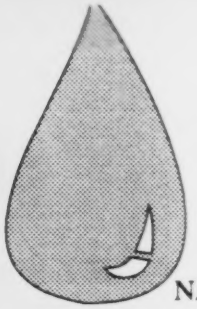
1. Tell students that the class is going to play a game that demonstrates water use and the reasons for conserving water.
2. As a group, list trips students take during a school day when they use water. Charge one ticket for each use of water on each trip. (Categories may include: drinking fountain, rest room, lunch, recess, etc.)
3. Give each student 30 tickets and an envelope in which to keep them. Have each student put her or his name on the tickets.
4. It costs the students one ticket each time they use water. Use a central collection box.
5. Have students keep a record of their water use.
6. Discussion Questions on the third and fourth day:
   a) On what kinds of things have you spent your water tickets? On some activities more than others?
   b) What if there were no water tickets left for the rest of the week?
   c) What can we do to save water?
   d) What can we do to get more water?
   e) If one person has some tickets left over, and another person doesn't, is it fair to trade?
   f) If you are out of tickets now, do you wish you had saved some for later?
   g) If you played this game again, would you do anything differently?

Notes...

7. List with students things that they can do to make the water they have (at home and at school) go further. This list may include: turn water off while brushing teeth (saves about 2 gallons); take a short shower instead of a bath (saves at least 24 gallons); shut off dripping faucets (saves 1,000 gallons or more per year); turn the faucet off while soaping your hands, hair, or body; only get water in restaurants when you are going to drink it; etc.

EXTENSION

Have older students write an essay entitled "The Day the Water Ran Out," and discuss that topic in class. Have younger students talk about what would happen if the water ran out. Reprint water tickets.



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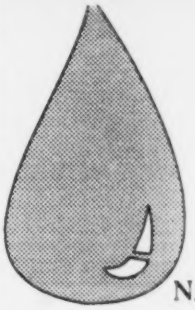

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Notes...

Water Cycle - Activity

OBJECTIVE

Students will understand that circle and cycles are continuous and have no beginning or end. Students will understand that the same water is used over and over again and that there will never be any "new water." Students will be able to identify the parts of the water cycle.

MATERIALS

water cycle component pictures

sample water cycle story

tape

glove

strip (4" x 18") of light-colored paper (1 per student)

crayons

optional: hula hoop or cardboard circle to tape pictures to.

BACKGROUND

Constant winter rains, groundwater slowly seeping downward between particles of sand, gravel and clay or through fractures in rock; springtime rivers at flood stage; waves lapping on the shore of Puget Sound; water in its various forms, is constantly moving. Its journey traces an endless circle from the atmosphere to the land surface, under the ground, into large bodies of water, and back to the atmosphere again. The water cycle, or *hydrologic cycle*, describes the various paths that water follows on its never-ending journey.

The *water cycle* involves the processes of *evaporation* (water being warmed and changing from a liquid to a gas), *condensation* (water in the atmosphere cooling and forming water droplets), *precipitation* (water in the air joining together and falling to the earth as rain, snow, sleet or hail, *runoff* (water flowing off the surface of the land directly into streams, lake or wetlands), and *infiltration* (water moving between particles of soil, sand, gravel and clay or through fractures in rock).

Heat from the sun causes water to evaporate from bodies of water, the land surface, the leaves of plants, and other objects on the earth. Everyone has seen steam rising from a pot of boiling water. Water vapor enters the atmosphere, and is moved by winds and air currents. As it moves upward, it cools. Cool air holds less moisture than warm air, so water vapor condenses. Tiny water droplets form around small particles in the air. Particles of sea salt, dust or smoke may serve as the "nuclei" for these droplets. As the air continues to cool, more droplets gather together and a cloud is born. Eventually, if conditions are right, the water droplets grow

large and heavy. The force of gravity pulls them to earth as precipitation (rain, snow, sleet or hail).

Some of this precipitation evaporates before it reaches the earth. Some falls directly into oceans, lakes, rivers or other bodies of water. Precipitation that falls on the land can take many paths. Water that wets the surface of the ground, or buildings, or grass and trees evaporates quickly. Some water runs off into ditches, streams, rivers, lakes or wetlands. Some seeps into the soil near the surface of the ground and is used by plants. If enough precipitation falls on the land, some of it percolates through the soil by the force of gravity and reaches an area where all the spaces between particles are filled with water. This is groundwater.

Groundwater moves very slowly, often only a few feet per year. It moves in all directions, through sand, gravel, clay and even through fractures in rock. Humans draw some groundwater up to the surface via wells. But much of the groundwater stays beneath the surface, travelling slowly until it emerges in our lakes, rivers, springs or wetlands. As water evaporates from these bodies, the cycle continues.

The cycle goes on and on. Water vapor, clouds, rain and snow, plants and animals, groundwater, lakes, rivers, oceans, and back to the atmosphere again. The goal of this activity is to help students understand that water moves in a continuous cycle, like a circle, with no beginning or end. Most of the water on earth has been here for billions of years. The same water will be used for ages to come. It's our responsibility to take care of what we have.

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PROCEDURE

1. Have students sit in a circle. Show them a globe or poster of the earth. *What shape is the earth?* Circle. Round. Sphere. Ask students to look around the room and see if they can find other things that have this shape.
2. Tell your students they are going to learn about a circle or cycle that happens in nature. This cycle, like all good cycles keeps going around and around and doesn't have a beginning or an end.
3. Tape the cutouts of the components of the water cycle to a hula hoop or a circle of poster board as you explain the water cycle. Include the arrows to show the direction of the cycle. Use the Background Information as a basis for your story. Include the following components, although it's not necessary to use the formal terms: water turning into water vapor and going into the air (evaporation), water vapor cooling and turning into water droplets (condensation), water falling in the form of rain or snow (precipitation), water moving through the ground

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(infiltration), and water moving between particles of soil, sand, gravel, clay, or through cracks in rocks (groundwater). Water that moves through plants and animals, including humans, can also be part of your story.

4. Be sure to include more than once, several components of the water cycle. This demonstrates the fact that water continues to be "recycled".

5. Give each student a strip of light colored or white paper (4" x 18") and crayons or markers. Have each student draw pictures to represent the water cycle on the strip of paper. Demonstrate the construction of the circle. Have them tape or glue the ends together, forming a circle of paper with the water cycle drawings on the outside. Students can turn the circle to show the different parts of the water cycle.

6. Let several students explain water's journey through the water cycle, using their water cycle circles. Review the basic parts of the water cycle.

7. Have students tell or write stories about the history of a drop of water, including where it has been and what it has seen. This can be done in various ways:

a. Hold up a glass of water. Tell the students that you are going to honor the "water cycle" by telling some of its adventures. Give them some examples, such as: "This water was in a huge thundercloud that rained on us last week," or "This water has been underground for 50 years and was just brought up when they put in the new well for the school." Let each student take the cup and tell where the water might have been. Encourage creative ideas, especially ones that incorporate history or mention different parts of the globe.

b. Sit in a circle. One student chooses a place on the water cycle circle to begin the story. The circle is then passed to the next student, who turns the circle and adds to the story.

c. In small groups, students can create stories and then act them out for the whole class.

d. Children can draw pictures or write stories individually.

EXTENSION

Given a picture of water in some location or form (e.g., a lake, clouds or snow), students explain in several steps how the water got there and where it might go next.

Identify places on a globe or world map that were mentioned when honoring the water cycle. Choose additional places on the globe and make up water stories about them.

Make a terrarium for your classroom. Add a measured amount of water. Put it in a place where students can easily observe it. Every few days, ask them for observations about what it happening inside this miniature water cycle.

What would life be like it, if instead of rain and snow, the clouds spilled orange juice and ice tea? What if a typical daily weather forecast was not "partly sunny, slight chance of rain," but "eggs and toast in the morning, changing to hamburgers by noon"? Read the picture book, **Cloudy With a Chance of Meatballs** by Judith Barrett (1978, Atheneum Publishers). Let your students write and illustrate their own weather report for the land of Chewandswallow! Collect all the forecasts into one class book.

FOR OLDER STUDENTS

When conducting the honor ceremony, encourage students to include "great moments in water history," such as: "There is a drop of water in this cup that was in glacier ice on top of Mount Everest in Nepal when the first climbers reached the top" or "Paul Revere gave a drop of this water to his horse after his famous ride."

Activity Source: GEE-WOW! Adventures in Water Education. Ecology Center of Ann Arbor. 1990. Ann Arbor, MI.

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How Water Fits Underground - Activity

OBJECTIVE

To explain that groundwater fills the spaces between particles, and to learn about the water table.

SUMMARY

Students, working in groups, build a simulated aquifer, identify the water table, and learn how water is stored underground.

MATERIALS

Each group of 3 - 5 students needs:

1 clear cup filled to the top with pea or aquarium gravel and half-filled with water

1 clear cup filled halfway with sand

1 cup filled 1/3 with water

1 crayon or 2 pieces of tape

BACKGROUND

When water hits the ground, gravity pulls it through the pores in the soil until it reaches a depth where all of the spaces between the particles are filled with water. The water level at this point is called the water table. The water table can be affected by various factors. It can rise during high periods of rainfall, and fall during a drought.

Below the water table, all the spaces between particles are filled with water, also known as groundwater. When there is an underground, saturated, permeable, geologic formation capable of producing significant amounts of water in a well or spring, it is called an aquifer.

Nearly 90% of all aquifers developed for water supplies are composed of sands and gravels. Porous sandstone, limestone, and highly-fractured crystalline and volcanic rock are other common aquifer materials.

PROCEDURE

1. Divide students into groups and hand out cups containing gravel and water. Ask students to examine the material in their cup and describe where the water fits in it (*between gravel particles).* Explain that water found in the ground is groundwater. This is like the water found under the earth's surface.

2. Have each group find the top of the water in the cup, and using a crayon or piece of tape, mark it on their cup. Explain that this is the water table.

3. Distribute one cup of sand, and one cup of water to each group. Have students examine the sand for things like particle size, color, texture, and share their observations with the group.
4. Students should slowly pour the water into the cup of sand. Those not pouring should be carefully observing where the water goes. *(It fills up the spaces between the sand particles.)* They should also watch for the telltale bubbles of air that may form as air is being forced out of the spaces between particles by the incoming water.
5. Ask students to mark the water table in the cup of sand and water with a crayon or tape.
6. One student in each group should make a hole in the sand with their finger or a pencil. A small pool of water will form in the hole. The top surface of the water in this pool is the water table.
7. Have students feel the sand on the top. How does it feel? Why? *(The sand at the top of the cup is dry or damp. It is not saturated, like the sand under the water table.)*
8. Have students poke a hole in the bottom of their cups, and let the water drain out the bottom. Then, feel the sand. Is it dry or damp? *(Damp)* Why? *(Because some water sticks to the grains of sand.)*
9. Discussion Questions:

   a) What happens to the water that comes down when it rains or snows? *(It runs off into lakes or ponds, evaporates into the air, or sinks down into the ground and travels to the water table.*

   b) What was between the sand or gravel particles before water was poured into the cups? What is between sediment particles underground if there is no water there? *(Air, which is displaced by the water.)*

   c) How far underground is the water table? *(The depth of the water table varies with the area. In most lakes and streams, the water table is visible to people. In other places, it can be just a few to several hundred feet under the ground.)*

   d) Why is a water table important to life on Earth? *(People use wells to reach the water table and draw up water. When the water table is at the surface, as with lakes and streams, all the plants and animals in the lake or stream depend on the water in the water table to exist in their habitat.)*

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Economic Strength

The economic benefits that a wetland provides can be substantial. In some parts of the country trade depends heavily on wetlands. Many of the fur bearing animals like beaver, muskrat, otters and raccoons live in wetlands. Alligators are hunted for their meat and pelts. Waterfowl, fish, shellfish, and peat bring in millions of dollars every year.[1] People spend millions of dollars on recreational activities such as boating and fishing on lakes like Lake Washington, Lake Sammamish and on Puget Sound. They buy boats, fishing equipment, clothes, gasoline, cameras, gifts, food and lodging[2]. All of these mean money and jobs for those of us living in King County.

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[1] *The harvest of wetland vegetation can be destructive for the wetland. The harvesting of peat, for gardens and as a heat source, for instance, means the destruction of the wetland. Peat is a nonrenewable resource. It takes up to 100 years for one inch of peat to accumulate. The over harvesting of wetland animals can also mean their extinction.*

[2] *It is important to be aware of our impact on wetlands. Horses, dirt bikes, motorcycles and mountain bikes may impact the soil, plants and wildlife habitat. Motorboats can disrupt wildlife and wetlands along the shores of rivers and lakes. Boat wakes can cause shore erosion in heavily used areas.*

Education And Research

Certain plants and animals that are found in wetlands do not exist anywhere else. There are over 5000 species of wetland plants nationwide. This diversity creates habitat for every form of animal life, including insects, amphibians, reptiles, mammals and birds. The relationships of these plants and animals are easily observed in wetlands making them excellent locations for teaching environmental science. Research for *botany* — study of plants, *ornithology* — study of birds, *hydrology* — the study of water and *ecology* — the study of relationships of organisms and their environment.

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IMPORTANT NOTES

3

The Power of Wetland Plants:

See Them, Touch Them, Taste Them

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Wetland Plants

A second charateristic of wetlands is their plants. The special plants that have adapted to life in wetlands are called hydrophytes.

Wetland plants are unique for their ability to grow in wet, oxygen deficient soil. Wetland soil, which is saturated with water, contains less oxygen because water contains less oxygen than air. As a result, wetland plants have either structural or physiological adaptations which allow them to survive. Some structural adaptations include a system of "air spaces" which allow air to travel from the exposed parts of a plant to the roots. Because of this, some wetland plants contain up to 60% air. Another characteristic of wetland plants include an arrangement of pores over the whole surface of a plant, which allows the plant to absorb gases. Some may have leaves which float on the surface of the water, that allow the necessary exchange of gases to take place. A physiological adaptation may allow some types of plants to use carbon dioxide more efficiently than other plants.

Most wetland plant species live in both wetland and non-wetland environments. In fact, out of almost 7000 plant species which have been found in U.S. wetlands, only 27% will almost always be found in wetland soil. In order to determine a wetlands status based upon its vegetation, a grouping system was created. This system is used by wetland biologists to determine the existence and importance of wetland areas. The "wetland indicator status" is broken down into two groups:

1. *Obligates* - plants found in wetlands at least 99% of the time, such as cattail
2. *Facultative* - plants found in wetlands at least 33% of the time, such as horsetail and alder

Plants are a crucial part of a wetland ecosystem, as they perform many necessary functions. Wetland plants are one of the three factors (the other two are water and type of soil) used to identify wetland environments. The plants provide food, cover, and breeding areas for wildlife. Plants also help to moderate temperature, which is very important for species such as fish, who need the cool temperature to regulate their body heat. Wetland plants are sometimes called a *biological indicator* determining the health of the ecosystem. Any change in plant population, diversity, or plant species could change a whole ecosystem. This concept is an example of how intercon-

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nected ecosystems are. Another important function of many wetland plants is to take in pollutants. As a result, wetlands are often called "the kidneys of the landscape," as they take harmful pollutants out of the water. On the same note, the roots of some wetlands plants bind the soil together, controlling erosion, and helping to control flooding.

Wetland vegetation performs many important functions and many find its beauty aesthetically pleasing as well.

Wetlands characteristically have specific varieties of vegetation. Open water wetlands, which have water depths of over three feet, tend to have *submergent* (below water) and "floating-leaved" plants like water milfoil and pond lilies. Within deep marshes, which have 1 to 3 feet of water, the dominant plants tend to be *emergent* (above water) like cattails. Additionally deep marshes contain submergent and "floating leaved" species. Shallow marshes, less than 1 foot of water, similarly maintain emergent vegetation, for example water parsley. Wet meadows, which have up to six inches of standing water, tend to contain meadow emergents as the dominant vegetation which include reed canary grass and sedges.

Wet meadows often contain other types of emergent plants found shooting out of standing water like cattails. Shrub/scrub wetlands, which are seasonally or permanently flooded, will tend to have shrub cover like hard hack/spirea and willow. Forested wetlands have many layers of vegetation, usually with trees such as black willow, red alder and western red cedar as the top layer, descending with shrubs like salmon berry, lady fern and devil's club as undergrowth.

Teaching Children About Plants

Many teachers hesitate to go outside with their students because they feel that they know so little about the plants (and animals) around them. But names don't tell us about the way a plant fits into its environment. We learn about our world by watching quietly. By listening with open eyes. Let your imagination and enthusiasm guide you. Your students will follow suit. To teach, first:

1. Find out what students already know about a subject.
2. Become comfortable with your subject. The more at ease you are with basic objectives, the more you can let a class pursue a variety of paths toward that objective.
3. Explain your intentions, plan and schedule with your class. Whenever appropriate, involve children in decisions and honor their choices.
4. Learn with the students. You don't need to be a walking encyclopedia of facts to lead a good field trip. How you react to something speaks so loudly that often people don't hear what you are saying. Be an enthusiastic facilitator rather than a boring lecturer. It's ok to say, "I don't know, but let's find out".
5. Teach by example: go quietly, stopping to look and listen, smell things, handle living things gently.
6. Put yourself in the learner's shoes. Take into account what a child is experiencing, both physically and intellectually.
7. Reinforce discovery. When a student points out a flower or another plant, this is the most important thing in the world to him or her, at that moment. Respond with enthusiasm to the discovery and call the group together if possible to share the find. Children are impressed by their own discoveries. Hopefully your own discoveries will excite you; share them! Enthusiasm is a greater catalyst than knowing lists of names.
8. Watch a student's body language. Learn the look of excitement, relaxed enjoyment, the flush of discovery. Share children's pleasure without overwhelming them. Learn the look of uncertainty, distrust, and confusion. Often these feelings can be diluted by a little individual attention.
9. Use questioning skills. Discussions are better than lectures at encouraging participation and involvement from a group. Open-ended, stimulating questions encourage thinking. "Why is this plant living here?" "What would you need to live here?" "Does this plant have anything that helps it live here?" These are examples of questions that promote thinking and group interaction.

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10. Let students know that your information came from someone else and can be passed on by them with the same confidence.
11. To encourage whole group participation, it is important that there is a call for individual responses, not a right answer or best drawing.
12. Be as accurate as possible with common names. Use your knowledge to help others figure things out. If a group seems involved in the question and is on the right track, it is all right to leave them excited about the pursuit without providing the definitive answer. Acknowledge their answers as good possibilities.
13. Label last. We are a culture of labelers. Often, once we know the name of something we turn off our attention, put it in its neat little box and search for something else to label. Names are good to know but so is information on what something is, why it does things, and other information.
14. Watch out for heavy moralizing on the destruction of the natural environment. Fear of pollution and species loss can be taught easily, but if the concepts are overloaded with emotion, the end result is likely to be an aversion to learning more. Concentrate on the joys of experiencing what is there at hand.
15. Ouch! Ouch! Ouch! Be the voice of the plants and animals when students, in their eagerness, get careless. Try to impart an ethic without negativism.
16. Express your feelings and values, but don't expect others to respect them unless you can respect theirs and show it.
17. Many experiences not necessarily understood by small children, but are still valuable as building blocks for future knowledge.

Little Green Monsters - Activity

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OBJECTIVE

Identify wetland plants and describe how they are adapted to their habitats.

BACKGROUND

Some plants devour insects, others soak up to 25 times their weight in water, and one can produce enough heat to melt snow. It may sound like science fiction, but certain wetland plants can really do these things. In this activity your children will be separating imaginary wetland "monsters" from real plants that are just as strange.

MATERIALS

copies of the Little Green Monsters (page 31)

construction paper

scissors

glue

crayons or markers

stapler

pencils

PROCEDURE

Pass out a pencil and a copy of the "Little Green Monsters" page to each child. Tell the children that some of the plants on the page are real wetland plants. (Point out that cartoons do not look exactly like real plants. For example, real plants do not have eyes!) As you briefly discuss each plant (using the following numbered information), the children must decide if the plant is real or not. If they think the plant really does exist, they should circle the number next to the plant.

The background information we've provided includes brief descriptions of each plant. For the quiz, read only the description of the plant, not its name. You can add the additional information later when you discuss the plants that are real. Tell children to concentrate on the explanations that you read to decide if the plants are real or not.

After the children have finished, discuss their answers and tell them which plants are real. Also show them pictures of the real "monsters" as you discuss them.

1. **(Venus Flytrap —real):** This plant has sensitive trigger hairs on the inside of each leaf. If an insect brushes against at least two hairs, the leaf will close, trapping the insect. Then the plant gradually digests

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the insect's soft parts, leaving the hard parts "uneaten".

This carnivorous plant grows in the marshes of North and South Carolina. Today Venus flytraps are rare because many people have dug up the plants to take home or sell in plant shops.

Please Note: In the discussion you may want to point out to the children that, like all other *carnivorous* plants, Venus flytraps can grow without digesting insects or other small creatures. (Like other plants, carnivorous plants make food through photosynthesis.) But they will grow better with an "animal supplement" to their diets. Insects and other small creatures provide nutrients that aren't abundant in some wetlands.

2. **(Three-Leaved Stick 'Um Plant — imaginary):** This small plant has a special way of getting around. Its seeds stick onto the fur of passing animals. The plant sprouts while still on an animal and grows there for a few weeks. During this time it survives on food stored in its seed coat. When it reaches a certain size it drops off and takes root.

3. **(Hooded Pitcher Plant — real):** Each of this plant's leaves forms a special "pitcher", and nectar on the lip of the pitcher attracts insects. But the surface around the lip is very slippery. As the insects crawl or land near the lip, many fall into the long, hollow leaf that ends in a pool of water and digestive acids.

   Downward-pointing hairs and the slippery walls of the plant prevent insects from crawling up and out of the "pitcher". The insects drown and are slowly digested until nothing remains but their hard outer coverings and wings.

   Hooded pitcher plants have another trick that is unique among different kinds of pitcher plants. They have transparent "windows" in the back of their "hoods" that look like escape routes. Insects that attempt to fly away crash into the hood, then fall into the pool below.

   These plants grow in marshes, bogs, and other wetlands from North Carolina to Florida.

4. **(Shoveler Plant – imaginary):** This wetland plant has a special adaptation that helps it survive in overcrowded areas. As it breaks through the soil, two large leaves grow on either side of the main bud. These leaves grow outward and uproot any other plants that are in the way.

5. **(Round-Leaved Sundew — real):** The leaves of this plant are covered with many short stalks. Each stalk is tipped with sticky nectar. Insects attracted to the nectar land on the stalks and become stuck. As they struggle to escape they become more firmly trapped. The stalks slowly move the insect to the center of the leaf. The edges of the leaf

then slowly fold around the insect and digestion begins.

The sundew gets its name from the way sunlight glistens on the liquid-tipped hairs.

6. **(Horned Bladderwort — real):** This water dwelling plant eats small aquatic insects and other animals. It's leaves and stalks are lined with many small, balloon-like bladders. Each bladder has a trapdoor. If a small insect brushes against the sensitive hairs around the trapdoor, it is quickly sucked through the trapdoor and slowly digested.

   Bladderworts grow in the shallow waters of marshes, bogs and swamps, found throughout North America.

7. **(Sphagnum Moss — real):** This plant often grows in open water or on the surface of moist soil. Gas filled cells keep it floating near the water's surface. The cells are specially designed to soak up water. In fact, each plant can absorb as much as 25 times its own weight in water! The plants uses this extra water during droughts.

   Sphagnum moss is often the first plant to grow in a bog. Younger plants grow on top of older plants. As the older layers die, they eventually form thick deposits of peat. In the past, people have used peat to heat their homes, stop wounds from bleeding, and to make super-absorbant diapers. Some people use it to condition the soil in their gardens. However, this practice isn't recommended anymore, as it depletes the slow growing peat bogs.

8. **(Tentacle Plant — imaginary):** This plant has long, sticky tentacles that grow out in all directions from its base. If an insect — or some other small creature — touches a tentacle, it gets stuck. The tentacle slowly curls around the victim, squeezing it tightly. Nutrients are sucked from the victim and passed through the tentacle to the rest of the plant.

9. **(Skunk Cabbage — real):** This plant begins growing very early in the spring each year — sometimes when snow is still on the ground. As the plant pushes through the soil, it produces heat by breaking down food reserves stored in its roots. The plant may get so warm that it melts the snow surronding it! This heat helps protect the plant's delicate flower.

   Scientists aren't sure why the skunk cabbage starts growing so early each year. But they think it must give the plant some advantage over the other plants growing in the area. Skunk cabbage has another unusual adaption. It gives off a skunk like odor that attracts flies and other insects which help pollinate the plant.

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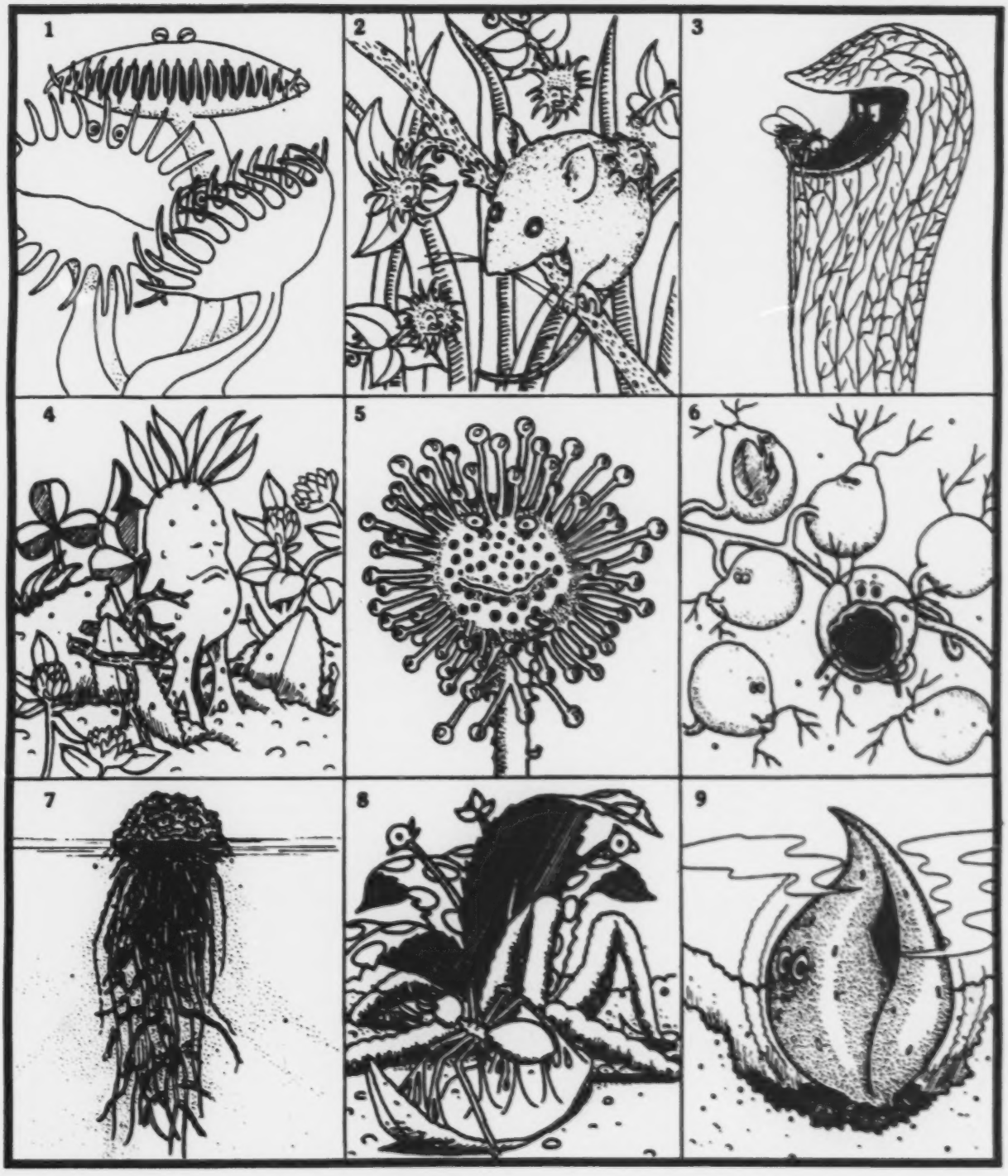
Little Green Monsters



Activity Source: National Wildlife Federation, Ranger Rick's Nature Scope, WADING INTO WETLANDS, 1989

MicroTrails - Activity

OBJECTIVE

To develop students' observation skills and awareness of diversity of plant life. Enhance public speaking skills. Good whole language activity.

MATERIALS

popsicle sticks
magnifying glasses
staples
index cards
yarn

PROCEDURE

Divide group into four or five children. Give each group some brightly colored yarn, 5 to 10 popsicle sticks, index cards, markers, and magnifying glasses. Bring a stapler outside for the children to use when they are ready to staple their index cards to their popsicle sticks. Designate a natural area for the children to design their trails. They may want to choose a "theme" for their project, such as a math trail, a sensory trail, or a trail marking animal's homes. They should make up questions about points of interest along the trail and write them on the index cards. Staple the cards to the popsicle sticks. Then push the sticks into the ground along the trail. Interesting creatures may be left in the magnifying boxes at some of the stations. Connect all the markers with yarn.

Here are some sample questions:

Who do you think lives in the hole in this tree?

How many legs does the creature in the magnifying box have?

What caused the soil erosion here?

Children will enjoy creating their own trail as well as following the trails of other groups. Another variable is to divide group into several smaller groups of 5-6 children. Have mini trails set up in different locations. Beginning with a teacher or leader for each group, describe the trail as it would look if she or he was an ant. The next student continues with the story at the second popsicle stick, and so on until each student has been involved with the story and the trail. The last student would conclude the story.

Activity Source: Conejo Recreation and Park District "Naturalist Guide"

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To Describe... - Activity

OBJECTIVE

Awareness of how plants are named. To help children accurately observe and describe plant and animal life.

BACKGROUND

Identification of collected organisms may be made with any of a number of general or detailed keys. Many children are interested in what the name of something is. However, it would be better not to bring identification manuals along on the first collecting trip, but rather to encourage your pupils to use their eyes (and some pencils and paper) to determine and draw or otherwise record the outstanding features of the different plants and animals they find.

Then they can give names to some organisms themselves. This can be an important lesson about how scientists name living things. A name is coined, based on the prominent characteristics of an organism, and a group of scientists agree to use those words as a name to refer to that particular species. Once the class has carefully named the organisms, then the teacher can raise the question of how people outside the class will know what is meant by a certain name. And from here it is an easy step to use the identification keys. Knowing the official name for a plant or animal will mean much more to children, because they will begin to understand how taxonomy is done and why it is so important.

MATERIALS

paper and pencil (for recorder)

pond objects (i.e. leaves,

frog eggs, insect larva)

PROCEDURE

Here is an activity which provides another way to demonstrate how important it is to choose words carefully when we are describing an object, and it is fun too! Have everybody sit in a circle (or divide up the class into 3 or 4 circles), and hand one of the children in the circle a pond object: a leaf, some frog eggs, an insect larva in a little jar, etc., without the others seeing. The first person looks at the object, secretly, and says one descriptive word which applies to the object. Then the object is passed on to the next person, and so on. Tell the children not to reveal the name of the object. Have someone record the words as the object is passed around. After a few rounds, discuss with the group how many words are really needed to describe objects uniquely, and go back over the list of words to show how the possibilities "narrowed down" as more words were added.

How many words does it take for the object to be identified by those who haven't seen it?

An interesting activity which can be suggested to the class at this point is to construct a key for identifying the organisms inhabiting the pond, using both class selected names and the official names. A good introduction to the "Plant Detective Activity."

Activity Source: Botany For All Ages, Jorie Hunken and the New England Wild Flower Society

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Plant Detective - Activity

OBJECTIVE

Develop observation skills and abilities to accurately and thoroughly describe plants.

BACKGROUND

Your students can be plant detectives. The object of the game is to describe a secret plant so well that another student can find it just by reading the description. Make sure to inform your students of any poisonous plant that might be in the area, like Poison Oak, Stinging Nettle or Nightshade.

MATERIALS

Two or more players

Paper and pencil for each player

PROCEDURE

1. Divide your class into two groups. Have each group choose a meeting spot.
2. Each person takes paper and pencil and goes away to find a secret plant.
3. Sit down beside your plant and look at it carefully. Smell it, touch it, see where it grows.
4. Write a description of your plant. These are clues to help a detective find it, so make it as complete as you can.
5. Go back to the meeting spot and wait for the rest of the students. When everyone is there, trade clues.
6. Take your new clues and try to find the plant. When you think you've found it, ask the describer if you're right (no hints except for what's written).
7. When you've found it, go back to the original meeting spot.

Variation: *Have your students "draw" the plant, based on the written description, and then pass the drawings on to other students, who then must find the original plant based on the student drawing.*

Activity Source: Botany For All Ages, Jorie Hunken and the New England Wild Flower Society

Native American Legends - Activity

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OBJECTIVE

Students will demonstrate how legends are used to explain observations of nature.

METHODS

After reading the Kathalamet legend of skunk cabbage, students write their own legends "explaining" wetland plants.

MATERIALS

Paper and pencil

PROCEDURES

1. Start this activity by explaining to students the nature of legends. Legends are often stories or myths that describe unexplainable things or events on earth. They are an important part of all cultures. The Kathalamet Indians, from Southwest Washington, have an interesting legend about the skunk cabbage, a wetland plant. Read the following aloud:

Kathalamet Legend of Skunk Cabbage

In ancient days there were no salmon. The people had nothing to eat except roots and leaves. One of their most important foods was the root of the skunk cabbage. Finally, after many years, the spring salmon came for the first time. As they passed up the river someone stood upon the shore and shouted: "Here come our relatives whose bodies are full of eggs. If it had not been for me all the people would have starved."

"Who speaks for us?" asked the salmon.

"Your uncle, the skunk cabbage," was the reply.

Then the salmon went ashore to see him, and as a reward for having fed the people, the skunk cabbage was given an elk-skin blanket and a war club, and was set in the rich, soft soil near the river. There he stands to this day, wrapped in his elk-skin blanket and holding aloft his war club.

Notes...

2. Ask students to write a legend of their own about a wetland plant.

   Remind them their plants may take personalities and do anything people can do. Some examples might be:

   - Why a plant lives in wetlands.
   - Why a plant looks like it does.
   - The plants relationship to another plant or animal.

3. Have students read their legends aloud to the class.

GRADE LEVEL VARIATIONS

K-3

Younger students may need their choices of plants narrowed down. They could also make a picture and tell about it orally.

9-12

Students may want to do outside research on plant uses.

EXTENSIONS

Act out the legends you have written.

Illustrate the legends and assemble them into a class book.

EVALUATION

Evaluate the quality of students' legends. You may want students to self-evaluate their legends. Develop a scoring rubric of quality with levels such as: exceptional quality, quality, not yet quality and clearly define each level so students can evaluate their own.

Source: Discovering Wetlands, 2nd Edition, Department of Ecology

Types of Wetland Plants

Here is a list of common plants found in local bogs, fens, marshes, shrub/scrub and forested wetlands.

TREES
Western Red Cedar
Sitka Spruce
Cascara
Black Cottonwood
Red Alder
Quaking Aspen
Bigleaf Maple
Western Hemlock
Oregon Ash

LARGE SHRUBS
Pacific Willow
Sitka Willow
Scouler Willow
Red Osier Dogwood
Twin Berry/Honeysuckle
Oceanspray
Red Elderberry
Indian Plum
Vine Maple
Cascara
Crabapple

SMALLER SHRUBS
Salmonberry
Spirea/Hardhack
Nootka Rose
Snowberry
Thimbleberry
Himalayan Blackberry
Evergreen Blackberry
Devils Club
Wild Cranberry
Bog Laurel
Labrador Tea

EMERGENTS/HERBS
Rushes
Horsetails
Reed Canary grass
Poison Hemlock
Deadly Nightshade
Butter and Egg
Stinging nettle
Fireweed
Cattail
Creeping Buttercup
Knotweed
Purple Loosestrife
Duckweed
Sedge
Iris
Skunk Cabbage
Lady Fern
Yellow Pond Lilly
Sphagnum Moss
Milfoil
Liverwort
Water Parsley
Marsh Cinquefoil
Burreed
Sundew
Wild Lily of the Valley
Monkey Flower
Foxtail
Cotton Grass
Bulrush
Peat Moss
Arrowhead

Notes...

Notes...

Wetland Plants: Getting to Know Them

This section will discuss many of the plants that live in our local forested wetlands, shrub/scrub communities, wet meadows, bogs and open water environments. Find out about many of the special adaptations these plants have made for life in or near water. Also learn about their value to wildlife, as well as how these plants were used in the past, and are currently used.

Cut and make your own plant cards.

Western Red Cedar, *Thuja plicata*

Bright red bark, peels in long strips. Buttressed at base, resistant to decay, due to natural fungicide in heartwood. 21' across, second only to giant sequoia in size among native trees.

- **Wildlife Uses:** Eat seeds, branches. Protective and nesting cover. Mature stands of trees provide cover for large mammals.
- **Historical Uses:** Known as "tree of life" Bark used for clothes, diapers, maps, sails. Roots for baskets. Trunk for totem poles and canoes.
- **Medicinal Uses:** Cedar buds used for toothaches. Tea for kidney troubles.
- **Current Uses:** Building materials for houses, decks, roofs, fences, shingles, siding, boat building. Incense.
- **Adaption To Water:** Forms "buttressed" roots, which keep the tree from falling over.

Notes...

Sitka Spruce, *Picea sitchensis*

180' - 200' Droopy branches.

Rarely grows more than 2-3 miles inland, thick buttressed roots. "Corn flake" bark. When touch needles, they will give you a "zap".

- **Wildlife Uses:** Eat seeds, provide cover and nesting areas. Needles eaten by grouse.
- **Historical Uses:** Pitch used for caulking boats. Roots for weaving baskets, snares, boats. Boughs for mattresses. Wood for sleds and tools. Rainhats. Sucked on small spruce cones as a treat. Sprouts eaten raw. Pitch used in chewing gum. "Spruce beer". Makah Indians decorated their hair with its leaves before going to sea.
- **Medicinal Uses:** Tea for coughs, colds, congestion and urinary problems. Sap for burns and sores, backaches, headaches & arthritis. Inner bark brewed for sore throats.
- **Current Uses:** Soaps, fresheners, cleaning products. Trees and boughs for Christmas decorations. Lumber. #1 timber tree in Alaska. Highest strength to weight ratio; used for ladders, doors, oars, organs, violins. Wood used for first airplane.

Black Cottonwood, *Populus balsamifera ssp trichocarpa*

Tallest native cottonwood. Largest is 147' in Oregon. Always found growing near open water/underwater. Fast growing, tall, suffers wind damage. Zillions of tufted wooly seeds; germinates best in wet river bottoms.

- **Wildlife Uses:** Cover. Nesting. Buds, catkins eaten by birds, rabbits. Mountain beavers eat leaves, buds, bark. Important nest tree for great blue heron, nest and roost tree for bald eagle, osprey, other raptors and cavity nesting birds.
- **Historical Uses:** Important for settlers/pioneers. Was the only shade around; indication of nearby water. Native Americans ate the sweet inner bark. Fuel for smoking fish. Gum used to waterproof baskets. Some Native Americans believed tree had a life of own, as shook even in no wind.
- **Medical Uses:** Buds used to reduce inflammation. Leaves used as antiseptic.
- **Current Uses:** Crates, paper, small utensils. Bees collect resin for use as anti-infectant and to seal out intruders. Landscaping; only males are planted; cottony seeds produced by females.

Notes...

Red Alder, *Alnus rubra*

Thickets short lived; intolerant of shade.

- **Wildlife Uses:** Goldfinch, chickadee eat seeds in cone. Elk, deer, beaver, eat twigs, leaves. Common nest tree for great blue heron.
- **Historical Uses:** Boiled bark produced dye to color hair, animal skin and fishing nets. Fish nets difficult for the fish to see. Wet leaves rid house of fleas.
- **Medicinal Uses:** Strong antibiotic qualities. Solution of bark used for tuberculosis, respiratory ailments and as a tonic.
- **Current Uses:** Chips for smoking fish. Excellent firewood. Pioneer plant after fire, logging. Puts nitrogen back in soil after land has been cleared. Feast bowls, masks and rattles. Leading hardwood tree in Northwest. Pulpwood; also used for furniture, cabinetwork.

Western Hemlock, *Tsuga heterophylla*

180' - 200'

State tree of Washington, climax tree of coastal forests. Droopy branch tips. Cones attached directly to branches.

- **Wildlife Uses:** Food for many birds. Cover and nesting. Understory tree.
- **Historical Uses:** Boiled bark for tanning hides. Dye. Hair remover. Carved into implements. Southeastern Alaska Indians made coarse bread from inner bark. Used to make dye, to dye paddles, dye for fishing nets so would be less visible to fish. Paint mixed with salmon eggs.
- **Medicinal Uses:** Tea from bark for colds, flu, fever, skin sores and sore throat. Pitch used to prevent sunburn/chapping. Nettles boiled in water to make decongestant.
- **Current Uses:** One of the most common trees in Pacific NW. Primary pulp source for paper in NW. (Makes finest paper fibers). Lumber for cabinets, crates, railroad ties. Flooring, siding, gym floors, resistant to scratching. Also source of alpha cellulose used for making cellophane, rayon yarns, plastics.
- **Adaption To Water:** Shallow root system.

Willow, *Salix sp.*

100 species native to North America.

Thickly matted roots prevent erosion along stream banks. 40 species reach size that qualifies as a tree.

- **Wildlife Uses:** Cover for birds and insects. Rats, birds and rabbits eat twigs. If over- browsed, inedible shoots grow.
- **Historical Uses:** Baskets, string, twine (from bark), tanning hides, dye.
- **Medicinal Uses:** Source of the natural precursor to aspirin. Curing warts.
- **Current Uses:** Furniture. Bark contains salicylic acid, natural aspirin.
- **Adaptation To Water:** Grow new air, filled roots to replace those flooded.

Elderberry, *Sambucus sp.*

Honeysuckle Family; cousin to snowberry. Red elderberry poisonous except for berries, which are too sour to eat.

- **Wildlife Uses:** 20 species of NW birds eat berries. Rodents, browsers eat the fruit, foliage, young twigs.
- **Historical Uses:** Latin name from the root word "sambuke" which means "musical instrument. Whistles, flutes since ancient times. Because poisonous, the bark is scraped off before making into flutes. Berries boiled into sauce. Branches used for arrow shafts, twirling sticks for making fire.
- **Medicinal Uses:** Insect repellent; bruise leaves, leave under hat. Eye wash, relaxant, salve for burns. Fever concoction from bark.
- **Current Uses:** Small carvings. Pitch used by watchmakers to absorb oil and grease. Dye.

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Devils Club, *Oplopanax horridus*

- **Wildlife Uses:** Some birds will eat the berries and bears relish the berries.
- **Historical Uses:** Northwest Coast Indians made charms out of plant. Roots worn as amulets to ward off evil. Protective face paint with grease; used for snuff, carved roots for fish lures; tied bits of bark to attract larger catches. Myth - thorns tipped with poison.
- **Medicinal Uses:** Believed to help prevent cancer, colds, insect bites. Related to ginseng. Dried pulverized bark used as baby powder/deodorant.
- **Current Uses:** Tea from inner bark used by many people today for diabetes.

Lady Fern, *Athyrium filix-femina*

- **Wildlife Uses:** Minimal
- **Historical Uses:** Food. Young fiddleheads served steamed, boiled as soup. Used for covering food. Washington Indians used a tea of boiled stems to relieve labor pains, and used for general body pain relief.
- **Medicinal Uses:** Dandruff. Has scruffy fiddlehead coating, rub on nettle rash to reduce itching and redness.
- **Current Uses:** Food - fiddleheads. One exception, Bracken ferns as they may possibly cause stomach cancer.

Notes...

Yellow Flag or Iris, *Iris sp.*

Greek for "rainbow" because of variegated colors of the flowers.

- **Wildlife Uses:** Popular bee flower
- **Historical Uses:** Perfumes. Leaves braided into snares for animals as large as elk. Rope/cordage.
- **Medicinal Uses:** Poultice for sores and swelling. Poisonous if eaten, would enlarge thyroid/lymphatic glands.
- **Current Uses:** Dye. Gardens

Stinging Nettles, *Urtica dioica*

The stings of the nettle are like hypodermic needles. The walls of sting cell are covered with a glass like substance called silica. When an animal brushes past the nettle, the stings puncture the skin and release a mix of irritating chemicals.

- **Wildlife Uses:** Towhees are among the birds that eat nettle seeds.
- **Historical Uses:** Sting of nettle helped Indian hunters stay awake at night during whaling excursions. Practice of eating cooked greens may have been introduced by Europeans (spinach substitute). Important source of fiber for making fish-nets, snares and trumplines. Fiber around since Egyptian times. Related to hemp. Substituted for flax during WWI and used for twine, cloth and paper; fabric for tents. Roots produce a yellow dye. To get rid of sting, smear affected area with mashed nettles.
- **Medicinal Uses:** General spring tonic
- **Current Uses:** Fiber. Nettle tea has earned worldwide reputation as an astringent and diuretic.

Notes...

Cattails, *Typha latifolia*

Wetland obligate: likes quiet, standing water.

- **Wildlife Uses:** Food for muskrats, geese. Nesting for red-wing blackbird, marsh wrens. Cover for many animals. Muskrats use plants in constructing houses.
- **Historical Uses:** Stem woven into baskets, mats, bedding. Spikes soaked in oil for torches. Down used for insulation in gloves and shoes and as life jacket insulation in WWI. Excellent food source and known as "Supermarket of the Swamp". Stems and flowers eaten raw or boiled; pollen used as flour. Immature flower spikes - corn on the cob. Succulent inner portion eaten.
- **Medicinal Uses:** Flowers mashed for salve for burns. Juice from stems rubbed on gums for toothache.
- **Current Uses:** Down used as stuffing for toys, caning for chairs. Food.
- **Adaption To Water:** Have seeds that float until they contact a suitable site for growth.

Horsetail, Equisetum sp.

Plants bear either male or female plants.

- **Wildlife Uses:** Horses like it, but too much can be toxic. Eaten by whistling swans, hungry bears.
- **Historical Uses:** Eaten by Romans like asparagus. Because of silica, substitute for fine sandpaper. Stalks used by knights to shine armor, by watchmakers and cabinetmakers as sandpaper and by Native Americans to polish arrow shafts, dishes, canoes, paddles. Pot scrubber. Dyes. As an invigorating body scrub. Spore core eaten with salmon eggs. Stem eaten with whale or seal oil.
- **Medicinal Uses:** Poultice for cancer-like growths, wounds. Tea for internal bleeding. Wash for insect bites. "Medicine Plant" liquid in stems applied to stinging nettle and other burns. Also applied ashes for burns. Hair rinse.
- **Current Uses:** First vascular plant to send green shoots up through debris of Mt. Saint Helens eruption. One tropical species grows to 30 feet, like the horsetail that grew during the time of dinosaurs.

Notes...

Nootka Rose, *Rosa nutkana*

Originally found and described from Nootka Sound, Vancouver Island, hence the name.

- **Wildlife Uses:** Good food source; fruit, buds, foliage
- **Historical Uses:** Branches used in steaming pits, cooking baskets and root-storage pits. Rose hips strung as necklaces. Also used for arrows and pipe stems. Jams, jellies. Each hip contains 350 - 500mg of vitamin C.
- **Medicinal Uses:** Buds, branches or strips of bark, boiled to make tea as an eyewash for cataracts or to enhance eyesight. Chewed leaves were applied to bee stings. Rose hips steeped, mashed and fed to babies with diarrhea.
- **Current Uses:** Soil binding characteristics, good for revegetation projects. Rosehip tea, eyewash.

Red-Osier Dogwood

Cornus stolonifera (relative of flowering dogwood). Showy reddish, purple twigs in winter.

- **Wildlife Uses:** Extremely important winter browse for moose, deer, elk and grouse. Buds and fruit eaten by birds and black bears.
- **Historical Uses:** Eaten by interior, aboriginal people. Bark dried and used as smoking mixtures by aboriginal East Coast people. Ornamental use.
- **Medicinal Uses:** Tonic tea made from the bark. Used for fishing weirs, sweatlodge frames, and fuel to smoke fish.
- **Current Uses:** Excellent soil binding characteristics.

Notes...

Skunk Cabbage, *Lysichiton americanum*

Wetland "obligate". Leaves appear after flowers are pollinated. First sign of spring, sometimes even found under snow. Pollination by carrion flies. Skunklike odor of the sap, and the fetid odor of flowers, draws in pollinators, like flies.

- **Wildlife Uses:** Food; seeds eaten by bear, elk, grouse, pheasants.
- **Historical Uses:** Famine food. Poisonous unless leaves dried thoroughly. Leaves used as wax paper to line berry baskets, steaming pits, and canoes. Rolled up to hold liquids or berries.
- **Medicinal Uses:** Cough, asthma, bronchitis, spasms, headache. Root hairs of plant applied for toothaches. Listed in U.S. pharmacopoeia from 1820 - 1882 for respiratory properties. Leaves were bound together and inhaled.

Spirea, *Spirea douglassii*

One of the many Northwest plants named after botanist, David Douglas.

- **Wildlife Uses:** A favorite nesting site of Common Yellow Throats and Virginia Rails (birds). Grouse eat leaves, deer browse. Insects lay eggs inside flowers.
- **Historical Uses:** Wiry, branching twigs were used to make broom-like implements to collect marine dentalia shells which were used as a form of currency.
- **Medicinal Uses:** Seeds boiled as tea for diarrhea.
- **Current Uses:** Today, often forms a monoculture, and little can grow underneath.

Pond Lily, *Nuphar polysepalum*

- **Wildlife Uses:** Provides a place for various insects and amphibians to lay their eggs, forms a protective habitat for young fish. Great place for frogs to rest. Rhizomes are eaten by beavers and muskrats.
- **Historical Uses:** Revered since times of Egyptians. Many Indian tribes used seeds for food, either by grinding into flour or roasting like popcorn. Plants called "westwind" in Hesquiat. Said to bring calmer weather if person took leaf and slapped against water yelling "Westwind, Westwind".
- **Medicinal Uses:** Colds, rheumatism, chest pains.
- **Current Uses:** Haida Indians still use for colds, rheumatism, chest pains.
- **Adaptation To Water:** Upper surface of pad is punctured by tiny pores (holes) through which the lily breathes air. The upper surface of the lily pad is also covered with a layer of wax so that water cannot collect on the surface of the pad and block the breathing pores. Has flexible stalks, roots are anchored in muddy bottom.

Hardstem Bulrush

Scirpus lacustris

- **Wildlife Uses:** Muskrats feed on rhizomes, use stems to construct dens, provides cover, nesting habitat for Western Grebe. Seeds important food source for birds.
- **Historical Uses:** Native Americans used stems for making baskets and mats, traded for mountain goat wool.
- **Medicinal Uses:** Used as an astringent, diuretic.
- **Current Uses:** Research has shown it has the ability to destroy pathogenic bacteria in soil or water near root zone. Originally imported by Europeans for caning chairs. Leaves still used for making duck blinds and emergency shelters.
- **Adaptation To Water:** Can live in up to 1 foot of water. Partially hollow stem to allow for diffusion of oxygen from aerial parts to roots.

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Notes...

Salmonberry, *Rubus spectabilis*

The apparent origin of their name, is from the common Native American practice of eating these berries along with salmon.

- **Wildlife Uses:** Birds, other animals love the berries, flowers important nectar source for hummingbirds.
- **Historical Uses:** Indians eagerly awaited this first berry of spring. Tender shoots eaten, woody shoots used as spears in throwing games, stems used as plugs for seal skin floats.
- **Medicinal Uses:** Astringent, boiled bark used to clean infected wounds and burns.
- **Current Uses:** Berries eaten.

Pondweed, *Potamogeton sp.*

(means river neighbor)

- **Wildlife Uses:** Food for at least 26 bird species, provide more food for ducks than any other plant. Insects, fish find shelter in foliage.
- **Historical Uses:** Roots, slightly nutty tasting were eaten raw in salads or cooked in stews.
- **Medicinal Uses:**
- **Current Uses:** Proven to remove heavy metals from water or soil in which they grow. Seeds sprout only after being in cold water for several months.
- **Adaptation To Water:** Many submerged plants give off oxygen bubbles, which dissolve in the water and are then available for many aquatic animals.

Notes...

Mountain Labrador Tea, *Ledum sp.*

- **Wildlife Uses:** Provides food for white-tailed deer and moose.
- **Historical Uses:** Fur traders and trappers often drank as substitute for expensive black tea, "trappers tea". Also popular during American Revolution when British teas were boycotted. Used as a moth repellent.
- **Medicinal Uses:** Slightly laxative, not good in large amounts.
- **Current Uses:** As a beverage.
- **Adaptation To Water:** Lives in acidic bogs.

Duck Weed, *Lemna minor*

Smallest flowering plant, 0.3 mm across. Has single root that dangles under plant, attached to nothing. In the fall, starch is stored in the fronds of the duckweed. Heavy starch causes plant to gradually sink to bottom of pond, where they overwinter. Starch is then used for food. In spring, little starch remains, and duckweed is light enough to float to the surface again.

- **Wildlife Uses:** Excellent food for ducks, as ducks get a "balanced meal" as they ingest small organisms along with the duckweed. Same for beavers and muskrats.
- **Medicinal Uses:**
- **Current Uses:**
- **Adaptation To Water:** Quickly covers surface of pond, because each tiny plant divides every few days. Many pond plants rely on vegetative reproduction to reproduce themselves. Also has an airfilled leaf stalk for buoyancy.

Notes...

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A Taste of Wetlands - Activity

Notes...

OBJECTIVE

Name some foods we get from wetlands. Discuss some ways people have used certain wetland plants through time.

BACKGROUND

Wetlands provide us many nutritious and tasty foods and have throughout history provided us with the essentials of survival. People can find a variety of edible plants in wetlands. For example, cranberries grow in wetlands. Cranberries are dried or made into cranberry juice, sauces or relishes. Certain kinds of mints like field mint grow in wetlands. So does wild rice and wild rose, the berries called rosehips are made into rosehip tea. Wetlands also produce a lot of seafood, from oysters to shrimp to crabs to flounder. Many other foods grow in wetlands that were eaten by (and are still eaten by) our native people. Did you know that the roots, shoots, stalks and even the pollen of cattails are edible?

MATERIALS

Plates, eating utensils, ingredients and utensils for making wetland treats (see individual recipes).

PROCEDURE

Introduce your student to a few of the "incredible edibles" that wetlands have to offer by trying some of these recipes. You may have the children make the recipes themselves, with your supervision. Use the information under "Did You Know"? to discuss each wetland "ingredient" as you taste your wetland edibles.

Did You Know?

Cranberries - Oxycoccus species

Wild cranberries grow in bogs and marshes. The cranberries people buy at the store are usually cultivated in specially prepared bogs in Washington, Massachusetts, New Jersey, Wisconsin and other states.

Early settlers called cranberry plants "crane berries" because they thought the pale pink cranberry blossoms looked like the head and neck of a crane. Later, "crane berry" got shortened to "cranberry".

Cranberries are high in vitamin C. In the 1800's, sailors took the berries on long voyages and ate them to prevent scurvy.

Indians ate cranberries and used them to make medicines and dyes.

Notes...

Cattails - Typha species
Cattails grow in freshwater marshes and swamps.

During World War I, cattail down (the fuzzy brown fluff from female flower heads) was used to make artificial silk.

Indians used cattails in many ways. For example, they used the flowers to make soups, breads, and puddings, and they used the pollen to make breads. They also roasted and ate the seeds.

Mint - Mentha species
There are more than 3,000 different species of plants belonging to the group known as mints. Some of these plants aren't commonly known to be mints. For example, catnip, rosemary, and thyme are all mints.

Many mints grow in freshwater marshes and along stream banks.

Indians used mint medicinally. For example, some Indians fed their children a special mint tea to get rid of worms.

Some mints are good sources of vitamin A and C.

Blueberries/Black Huckleberries - Vaccinium species
Often the difference between blueberries and huckleberries, is cited as one is cultivated "blueberry" and the other is "wild" - huckleberry.

More than 50% of our regions shrubs have fleshy fruits - which are often edible berries. (Why? Effective means of seed disposal).

There are 12 species of blueberries/huckleberries in the Pacific Northwest. The berries are choice food sources for bears, birds and people from mid-summer to fall.

The berries were an important part of coastal aboriginal people's diet. The juicy, flavorful berries were eaten fresh, or cooked mashed and dried into cakes.

Blueberry is a very common shrub and can be found in bogs, forested wetlands and swamps or wet, overgrown fields, depending on the species.

Incredible Edibles

Cranberry Ice

Most people are familiar with cranberry sauce and cranberry juice, but this treat is a bit more unusual - and it's one that's as good for you as it is good (cranberries are a good source of Vitamin C).

1 pound cranberries	2 cups water
2 cups sugar	1/4 cup lemon juice
1 tsp grated orange peel	2 cups cold water

Cook cranberries in 2 cups water until skins are broken, about 10 minutes. Rub the berries through a sieve to make smooth pulp (discard skins). Stir in sugar, lemon juice and orange peel. Stir in 2 cups cold water. Pour into square baking dish, 8x8x2 inches. Freeze, stirring several times to keep mixture smooth, until firm. Let stand at room temperature 10 minutes before serving.

(If you like, before it gets completely firm, you can spoon it into ice cube trays and insert popsicle sticks to make cranberry pops).

Cattail Pollen Pancakes

1 cup cattail pollen	1 cup flour
(see the end of the	1 tsp baking soda
recipe for directions	3/4 tsp salt
on how to collect	2 ¼ cup buttermilk
cattail pollen	2 tbls vegetable oil
shortening or butter for frying	

Sift together the cattail pollen, flour, soda, and salt. Stir together the buttermilk and oil. Add the liquid ingredients to the dry mixture, mix and set the batter aside until it thickens (about 10 minutes). Cook the pancakes on a hot, greased griddle. (Makes about a dozen six-inch pancakes. Try folding some of them and filling them with jam, jelly, or whipped cream).

Collecting cattail pollen: *Cattails usually bloom from May through July. The pollen is bright yellow and forms on the male flower spikes, which grow up from the brown, fuzzy "sausages" of the female flower heads. To gather the pollen, just bend the cattail stalk over and shake the pollen into a bucket or bag. (Get permission from landowners or park officials before collecting cattail pollen).*

Notes...

Notes...

Tangy Mint Tea

1 cup dried mint leaves
(spearmint or peppermint both work well)
1 quart boiling water
1 cinnamon stick
honey

Crumble dried mint leaves into small pieces and add them to the boiling water. Boil for about a minute, then remove the tea from the heat and let it steep for 15 minutes. For the last five minutes of steeping, add a cinnamon stick. Strain into cups. Add honey to taste, and serve hot or cold. Makes about four cups of tea.

Blueberry Grunt

Sauce:
4 cups blueberries
1½ cups sugar
2 tbls lemon juice
2 lemon rinds, grated
½ tsp cinnamon
½ tsp salt
3 cups water

Dumplings:
1 cup sifted flour
¼ cup sugar
2 tsp baking powder
½ tsp salt
3 tbl shortening or margarine
1/3 - 1/2 cup milk

1. Combine sauce ingredients in a heavy saucepan. Bring to a boil; reduce heat and simmer 5 minutes. Remove from burner and set aside.
2. Sift dry dumpling ingredients together into a bowl. Cut in shortening until crumbly. Add enough milk to make a sticky dough; do not overmix.
3. Simmer sauce again until bubbly. Drop dough from greased spoons onto the surface of the sauce. Cook uncovered 10 minutes. Cover tightly and cool 10 more minutes without lifting the lid!

The sauce from this sweet dessert also makes a delicious topping for pancakes or ice cream.

Source: Adapted from • National Wildlife Federation, Ranger Rick's Nature Scope, Wading Into Welands, 1989 • WOW: The Wonders of Wetlands.

Notes...

IMPORTANT NOTES

4

What's The Muck On Wetland Soils?

Notes...

The Nitty Gritty

The third characteristic of a wetland, is its soil type. A wetland or "hydric" soil is a soil that is wet long enough during the growing season (at least one week) that the soil begins to change and take on new characteristics. If the soil is flooded or saturated long enough, an anaerobic environment occurs. Anaerobic means "no" or low oxygen. In dryer upland soils there are small spaces between the individual pieces of sand and dirt. These spaces are filled with air/oxygen. In a wetland soil, these spaces are filled with water and oxygen is forced out.

Some physical characteristics of wetland soils that can be seen with the eye, are *gleying* and *mottling*. A *gleyed* soil is a soil that is gray, green or blue in color. Most of the other mineral's colors have been washed out. *Mottles* are small blotches of yellow to reddish brown found in the soil. These blotches are small concentrations of iron and manganese.

When the soil is flooded or saturated and depleted of oxygen, some of the minerals in the soil such as iron, manganese and sulfur are chemically changed and become toxic to certain plants. Many of the other minerals that upland plants depend on have been leached (washed) from the soil.

Hydric soils greatly influences the kinds of plants that are able to grow in that soil. Plants that have adapted to grow in these wet soils are called "hydrophytes." Hydrophytes are the only kind of plants able to survive in wet, anaerobic soils. Most plants absorb the oxygen they need from the soil through their roots. Hydrophytes have adapted structurally or physiologically to the saturated soil conditions.

When a wetland biologist is trying to determine whether or not an area is a wetland or where the wetland boundaries might be, s/he will always look at the color of the soil and look for mottling. The boundaries would be difficult to identify if plants and hydrology (water) were the only criteria. Water may not always be present (i.e. summer) and the plants may be dominated by plants that can also grow in upland areas (facultative vegetation). Soil characteristics, however, are very stable. They change very slowly over long periods of time. Soils are an important indicator of wetland conditions.

Notes...

Soil Science: Dig It - Activity

OBJECTIVE

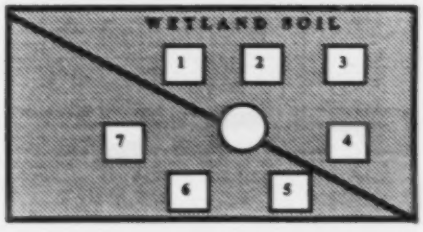
Students will be able to differentiate wetland soils from other types of soils.

BACKGROUND

Wetland soils look different from other soils. Sometimes wetlands are so wet that there is no air left between soil particles. Over time, the lack of oxygen causes a chemical reaction and the color of the soil changes. One of the things that wetland scientists look at when they visit a place is the color of the soil. This is one way that they can tell if an area is a wetland or not. They use a complicated set of color charts called a Munsell soil color book. You can make your own very simple soil color chart to look at wetland soils.

PROCEDURE

1. On a piece of white paper draw seven one inch squares as shown. Draw a circle in the middle a little larger than the size of a quarter.
2. Use Crayola Crayons from a box of 64 to color in the squares. It is very important to use the right color!
   1. Black
   2. Gray
   3. Seagreen + Gray
   4. Brown + Gray
   5. Tan
   6. Sepia
   7. Raw Sienna
3. Fold the paper in half and cut out the circle.
4. Dig a hole up to two feet deep. Remove golf ball sized pieces of soil from the side of the hole. Hold the soil behind your color chart so it shows through the hole. Try to match the color of the soil to one of the squares. If it nearly matches the boxes above the diagonal line, it may be a wetland soil! Look at soil samples from wetlands, your yard, fields and school. Just remember to get the landowners' permission before digging! What else is in the soil? Can you find old leaves and other organic material? Are there insects and animals? Secret treasure?



Activity Source: Adapted from ***WOW!: The Wonders of Wetlands****, Environmental Concern Inc., PO Box P, St. Michaels, Maryland 21663*

IMPORTANT NOTES

5

Why Are Wetlands Important?

Notes...

Many people have viewed wetlands simply as unimportant. Useless land that could be improved by draining it, filling it, or using it as a dumping ground for garbage. However, recent efforts to preserve and protect wetlands are due largely to a greater understanding of the many important ecological functions that wetlands perform and the values of these functions.

In this following section we will discuss several important functions of wetlands:

1. Pollution Control
2. Flood Control
3. Shoreline Stabilization/Erosion Control
4. Groundwater Recharge
5. Economic Strength
6. Education and Research
7. Wildlife

Many of the wetland functions listed here will have accompanying activities to help illustrate their value. Wildlife values will be discussed in the next section, **Come For A Visit, or Stay For A Lifetime.**

Notes...

Pollution Control

Wetlands can protect water quality by trapping sediments and absorbing excess nutrients and other pollutants such as heavy metals. Generally, the more plants in a wetland, the slower water flows and the more sediment is able to settle to the bottom. However, the whole story of pollutants in wetlands is unclear. In some cases the pollutants become trapped in the sediment and are either broken down into less harmful components, taken up through the roots or held in the soil. When the plant dies though, or when the soil is disturbed the pollutants can be released into the system again.

Wetlands can play an important role in purifying water, but they are unable to do all the work.

Polluting The Puget Sound Activity

OBJECTIVE

Students will become aware of the many ways that their local waterways may become polluted. Students will recognize that they can take positive actions to help prevent some of this pollution and realize that protecting the environment is not a "one time" event, but requires a change in our daily habits.

BACKGROUND

Those of us who live along Puget Sound recognize its scenic vistas, but we depend on it for much more - food, recreation and transportation. Unfortunately, we have not treated the Sound like the invaluable resource that it is. We use the waters to carry away our factory wastes and sewage. Chemicals leach from our spacious green lawns and croplands, soil erodes from our earth scraped bare by bulldozer or plow. Oil drips from our engines and acid rains from our skies or seeps from abandoned coal mines. Toxic household chemicals, unsightly litter, tangled fishing line and cigarette butts, all of which may be fatal to wildlife, are discarded thoughtlessly. Each section of Puget sound has its own personality - and problems. Some stretches of the Puget Sound are relatively clean; some are so polluted that they are on the EPA' Superfund list (established in 1980) of hazardous waste sites.

MATERIALS

The following is a list of materials required for a class of 30 students.

1. 2 clear gallon jars of water (almost full)
2. 1 labeled film canister for each student (available free at most camera stores)

There are 15 characters in the story, prepare two sets of canisters for each character.

Character/Source	Substance	Quantity/Condition
construction site	soil	1/4 - 1/2 teaspoon
trees	leaves	dry - to avoid mold
motor boar driver	vegetable oil	1/8 - 1/4 teaspoon
family picnic	litter	recyclable styrofoam, plastic, etc.
beach party	litter	pull-tabs, aluminum, etc.
people fishing	nylon line	tangle of line (cut up before disposing)
farmer	baking powder (fertilizer)	1/4 - 1/2 teaspoon
cow	muddy water/thick	small amount
homeowner	yellow water/toilet paper	1/2 - 1 tablespoon
Laundromat	soap/water (detergent)	1 drop of liquid soap in canister
paper mill	vinegar (acid rain)	1/4 - 1/2 canister
gardeners	baking soda (pesticide)	1/4 - 1/2 teaspoon
coal mine	vinegar (acid runoff)	1/2 canister
mysterious liquid	water with food color	5 drops of colored water
commuter	vinegar (acid runoff)	1/2 canister

Please Note: *All substances used in this exercise are nontoxic.*

PROCEDURE

Prepare and label film canisters ahead of time. Use the substances and amounts detailed on the materials list. A class of 30 students will be divided into two groups. If you have more than 30 students, give some students more than one character. Prepare a set of 15 canisters each labeled with its character for each group.

Begin with 15 students sitting in a circle around a jar of clear water. Distribute one canister to each student. Caution them not to open the canister yet. Tell them they will play the part of a character in a story about Puget Sound. Ask them to keep the identity of their character a secret.

Notes...

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Explain that you are going to tell a story of Puget Sound. When they hear the name of their character mentioned in the story, they are to empty the contents of their canister into the jar of water.

As you tell the story, you will stop periodically to ask the students if the water is clean. Would they eat seafood that lived in it? Would they swim, fish or boat in it?

The Story: Who Polluted Puget Sound?

Second Lieutenant Peter Puget explored the Puget Sound over 300 years ago. He wrote in his journal about the great forest filled with wildlife and the plentiful waters of Puget Sound which sustained he and his crew during their exploration. Let's take a look at the waters of Puget Sound today.

Q: This water is clean and pretty, isn't it?

It is beginning to rain. The soil from a nearby **construction site** without erosion control is being washed into Puget Sound. As the storm worsens, the wind in the **trees** blows leaves in the sound.

Q: Would you eat seafood that lived in it? Boat in it? Is it safe for wildlife?

At last, the sun comes out and people head for Puget Sound to have fun. As the **motorboat drivers** zoom up and down the coast a little oil gets into the water. The boats pass a **beach party** and a **family picnic** on the shore. These people leave trash on the shore that washes into the Sound during the next high tide. A **person fishing** from a dock gets nylon fishing line tangled on a barnacle covered rock in the water and breaks the line.

Q: Would you eat seafood that lived in it? Boat in it? Is it safe for wildlife?

There is a farm along a river that feeds into Puget Sound. The **farmer** has fertilized the fields and the rain washed some of the fertilizer off the land and into the river. In the barnyard is a **cow** and her calf. As the rain drains off the barnyard, it carries some of the manure in to the river which then flows into Puget Sound.

Upstream from the farm is a **coal mine**. The rain water flows into the mine and mixes with the mining wastes, causing the water to become acid. The acid water seeps through the ground and discharges into the river below, and into Puget Sound.

Q: Would you eat seafood that lived in it? Boat in it? Is it safe for wildlife?

On a hill overlooking Puget Sound is a big old house not connected to the city sewer system. Waste water from the house goes into an on-site septic tank. The **homeowner** does not know that the on-site septic tank leaks and untreated sewage is seeping into the creek which feeds the river that empties into Puget Sound.

The people in the house do laundry every week at the local **laundromat**. Faulty plumbing lets soapy water get into the river. If there are phosphates in the detergent, it will make too much algae grow in the river. It upsets nature's balance. When the algae dies and begins to rot, it uses up the oxygen and causes the water-dwelling animals to suffocate, like salmon.

Q: Would you swim in the water? Boat in it?

On the Sound there is a paper mill. The plant burns fuel to produce electricity to produce steam to dry the paper. But, polluting gases are also produced. Some of these gases escape into the atmosphere. Moisture in the air combines with these gases and acids are formed. So, when it rains or snows the acids fall to the ground and drain into the river which flows into Puget Sound.

In town, are many **single occupancy commuters** who drive cars to work. The car exhaust fumes add to the acid rain, and some of the parked cars drip oil or antifreeze which will be washed off the pavement and into the Sound with the next rain.

At home in town, a family is working in the yard. They want to finish gardening before it rains again. These **gardeners** use hazardous weed-killers and bug sprays to keep the pests away. When the rain starts, again it washes these poisons into the little creek behind the house which then flows into Puget Sound.

Another family is busy cleaning out the garage. They find some old, unlabeled rusty cans filled with a **mysterious liquid**. They aren't sure what it is, but it looks dangerous! They want to get rid of it. Someone gets an idea. "Let's pour it down the drain out by the curb. Hurry up before the storm starts again!" The toxic liquid goes down the storm drain. It is out of sight, but headed for Puget Sound.

Q: Who polluted the Puget Sound?

CONCLUSION

Ask the students "Who polluted Puget Sound?" Is it on person's fault? What is non-point pollution? Point pollution? Who is going to pay to clean it up? Is it cheaper to prevent pollution than it is to clean it up? Go over each activity and come up with list of practices that water pollution could have been prevented. Ask students to think of ways that they can help prevent some of these things from happening.

Notes...

Activity Source: Adapted from: Who Polluted the Potomac? Hard Bargain Farm, Alice Ferguson Foundation

Notes...

Flood Control And Reduction

A wetland cannot prevent a flood, but it can help reduce damage done downstream by storing the water and then releasing it slowly. Most wetlands are shallow basins that collect water and slow its rate of flow. This slowing process helps reduce flooding and also helps prevent soil erosion. Wetland plants and soils act like a "sponge" by soaking up water, much more water than other plant and soil types.

Shoreline Stabilization/Erosion Control

The root systems of wetland vegetation stabilizes stream banks and shorelines, guarding against erosion from tides, waves, wind and river currents. Wetland vegetation does this by binding soil and deposited sediments in its dense root system to keep them from being washed into streams

Wetland plants also slow down wind and water currents and help to reduce erosion. Without a wetland, excessive amounts of silt and pollutants can end up in rivers, lakes, and other bodies of water. Excess sediment (particles of soil) can settle into the gravel of a stream bed and can prevent fish from spawning by smothering fish eggs.

Wetland Models - Activity

OBJECTIVE

Learn what a wetland is and identify important wetland features.

BACKGROUND

It is hard to tell, just by looking at a wetland, that they help filter silt and pollutants from the water, help prevent soil erosion, and often reduce flood damage (see Wetland Vegetation section). But by building a simplified wetland model, you can demonstrate some of these important wetland functions.

MATERIALS

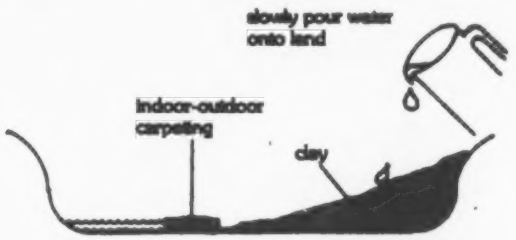
chalkboard or easel
Oasis (florist foam)
sponges
toothpicks
scissors
crayons or markers
glue
jar of muddy water
modeling clay
roasting pans
cotton swabs
cardboard
paper & pencils
reference books
poster paints
small piece of indoor-outdoor carpeting
pictures of wetlands and wetland plants and animals
pine needles, twigs, grass, weeds, soil, and other natural materials

PROCEDURES

First of all, make a demonstration model.

1. Spread the layer of modeling clay in half of the roasting pan to represent land. Leave the other half of the roasting pan empty to represent a lake or other large body of water, such as the Puget Sound.
2. Shape the clay so that it gradually slopes down to the body of water.

3. Smooth the clay along the sides of the pan to seal the edges. You can also form meandering streams in the clay that lead into the body of water.
4. Cut a piece of indoor-outdoor carpeting to completely fill the space across the pan along the edge of the clay (see diagram). The carpeting represents the wetland buffer between dry land and open water.



Begin the activity by asking children to list the characteristics of a wetland. Write their answers on a chalk board or large sheet of easel paper. Take a group survey to decide which characteristics might apply to all wetlands (see the section that discusses wetland types on page 3).

Notes...

Notes...

Now demonstrate some of the functions of a wetland using the wetland model. Explain that wetlands, like all habitats, are very complicated natural systems, and scientists are still learning more about how they work. Scientists already know that wetlands perform very important functions, such as filtering pollutants, reducing flood damage, and preventing soil erosion. Explain that your model will demonstrate some of these functions in a very simplified way. Here are a couple of the functions you can explain with your model:

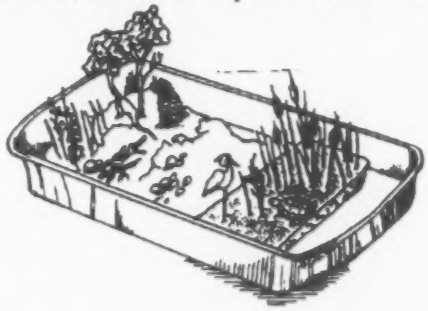
Flood Control: Fit a piece of the carpeting into the wetland area. Pour some water slowly on the land. Have the children describe what happens. (Some water is slowed down by the carpeting, which is acting as a wetland.)

Now remove the carpeting and the water. This time pour the same amount of water on the model at the same spot and same rate as before. Have the children notice any differences. (The water should fill the body of water much more quickly than before. That's because it's no longer buffered by the wetland. Explain that most wetlands are shallow basins that collect water and slow its rate of flow. This slowing process helps reduce flooding and also helps prevent soil erosion.)

Water Purification: Pour the water out of the model and replace the piece of carpeting in the wetland. Pour some muddy water from the jar onto the land. Ask the children to compare the water that ends up in the body of water with the water in the jar. (Explain that the soil particles are trapped by the carpeting, making the water that reaches the body of water much clearer.)

Remove the carpeting, pour out the water and try the experiment again. What happens without the wetlands in place? Ask the children why all the dirt particles end up in the body of water now? (The thick mat of plant roots in a wetland helps trap silt and some types of pollutants. Without a wetland, excessive amounts of silt and pollutants can end up in lakes, rivers, and other bodies of water. See Why Are Wetlands Important and Wetland Plant sections for more information.)

After demonstrating some wetland functions, discuss how wetlands are important wildlife habitats, as well as important recreation sites for people.



FOLLOW-UP

Now divide your group into smaller groups of about five each. Tell each group they will be making their own wetland models out of clay, using your model as an example. (Instead of using outdoor carpeting to represent a wetland, have them use Oasis (florist foam) molded into a very shallow basin. Then children can attach plants and animals to the model with toothpicks.) They can make a freshwater marsh, a salt marsh or a bog. Provide reference books so the children can see pictures of different types of wetlands. Then decorate the models according to the types of wetlands they are making. Here are some ideas: for cattails use cotton swabs painted brown, pieces of grass or toothpicks painted green with bits of brown clay stuck to the tops. Shape wetland creatures from clay or cut them from paper and use toothpicks to make them stand. Make trees by gluing pieces of green sponge onto twigs.

Activity Source: National Wildlife Federation, Ranger Rick's Nature Scope, WADING INTO WETLANDS, 1989.

Notes...

Notes...

Groundwater Recharge

Our groundwater and aquifers are replenished or recharged by rain water and melting snow that seeps into the ground. Fast moving water doesn't have as much of a chance to soak down into the ground as standing or slow moving water. A wetland, with its dense plant growth, slows the water and holds it like a sponge. The wetland slowly releases the water into the ground, replenishing water for stream, rivers and lakes for irrigation and drinking water.

Conservation

Both globally and here in the Pacific Northwest, many species of amphibians appear to be in the decline. Why? Reasons include:

1. Approximately 1/3 to 1/2 of wetland acerage in Washington and Oregon has been drained or filled in.
2. There has been an introduction of nonnative species such as Bullfrog (native to eastern and Midwestern United States and southeastern Canada) and Spiny-rayed fishes. These nonnative species eat amphibian eggs and larvae as well as adults (and baby birds).
3. Clear-cutting of forests also has resulted in the loss of amphibian habitat.
4. In addition, the pet trades, and the use of amphibian as fish bait has caused their decline.
5. Amphibians are believed to be affected by the thinning of the ozone layer. Experiments have determined that frogs are sensitive to ultraviolet light. There is now a worldwide study to determine if amphibian populations are declining more rapidly in areas of the world where the ozone layer is thinnest. A national amphibian population study is being done as part of this effort. The local part of this study is being done by King County's Department of Development and Environmental Services.
6. Amphibians are also sensitive to changes in water levels. In a study done on Northwest Salamanders, it was found that they consistently lay their eggs at a depth of 30 to 40 cm and all the tops of the egg clusters were the same distance from the surface of the water. Changes in water temperature can have a negative impact too, as can water pollution and loss of habitat.

Come For Just A Visit— Or Stay For A Lifetime

Notes...

Wetlands: Home For Wildlife

The fact that wetlands are wet makes them very important in providing habitats for wildlife. This rich, wet environment provides a great place for many types of plants which provide cover and food for 212 species of Western Washington wildlife.

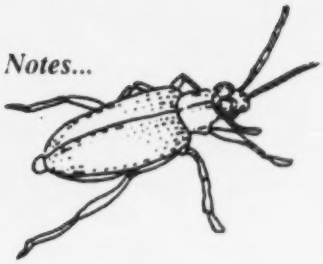
Wetland plants are the key providers of food and cover. Deer, insects and waterfowl feed directly on living plants. Many others, such as the Red-winged blackbird, make their home within the shelter provided by wetland plants. It is important to realize that dead, decomposed plants also serve a purpose. Organisms which carry out decomposition, such as bacteria and fungi turn these plants into nutrient-rich *detritus* which provides a foundation for the wetland food web. Small fish and invertebrates feed on this detritus and they, in turn, feed larger organisms.

The diverse wetland wildlife depends upon this habitat for feeding, breeding, rearing, resting and refuge. Many animals, such as beaver, muskrat and frogs are permanent residents while others, like salmon and many birds, only visit during certain times of the year.

Because they are so nutrient rich and provide ample cover, wetlands serve as major spawning and nursery areas for a wide variety of fish, amphibians, and shellfish. Migratory birds, especially waterfowl, rely on wetlands to provide a place where they can rest and feed. Washington's own Bowerman Basin and Skagit River Valley are excellent examples of this because of their huge migratory bird populations.

More than 50% of Washington's species of fish and wildlife are dependent upon wetlands for a portion of their life cycle. Therefore, when wetlands are filled or otherwise altered, these species are negatively affected. These species, whose populations can be permanently reduced by loss of a wetland habitat, are termed "priority species". The habitats upon which they are so closely dependent are called "priority habitats". A list of both for Washington State follows.

Notes...



Amphibians

What is an amphibian?

About 360 million years ago, amphibians evolved from fishes. The word amphibian means 'double life' which refers to the characteristic of spending part of the year on land and part in water, when they return to breed and lay their eggs. It also refers to the duel personality of amphibians as they transform from fish like aquatic larva to land dwelling frogs, salamanders, and toads. But, not all amphibians have this 'double life.'

Why are amphibians important?

Amphibians play an important role in the wetland food chain. The larva eat a variety of small invertebrates and insect larva, microscope algae, and some even eat other smaller amphibian larva. Adult frogs and toads eat tons of insects, including the notorious mosquito. Salamanders eat not only insects but slugs, snails, other amphibians, snakes and even shrews and mice.

In addition to being an important part of the food chain, amphibians are valuable to us in other ways. They have a complex immune system that may teach us a great deal about our own immune system and diseases that affect the immune system. When amphibians are stressed from changes in their environment, their immune system breaks down and they get bacterial infections. Pharmaceuticals have been developed from studying amphibians. Anti-fungal cream for athlete's foot is a good example. By studying amphibians we may learn a great deal about how changes in the environment could affect our own health and well-being. Amphibians are also an indicator species of the health of our wetlands and possibly the earth's environment in general.

Common Local Amphibians

Notes...

Pacific Chorus Frog

- **Description:** Dark mask extending from nostrils to shoulder. Toes have round toe pads with little webbing. Y-shaped mark on back of head between eyes. Males throat is dark and wrinkled. Approximately 2 inches in length.
- **Habits and Habitat:** Most common frog in our area. Lives in forest, pastures and urban areas. Males are extremely noisy in the evenings and when it rains. Toe pads help them to climb vegetation in search of food, like spiders and insects. Breeding occurs February - June in shallow, (often seasonal) vegetated wetlands. Females lay small loose egg masses of 10 - 70 eggs, attached to grass, stems or sticks.

Red-Legged Frog

- **Description:** Brown or reddish in color with small black spots on it's back and sides and dark bands across legs. Underside of hind legs, red or orange. White throat. Long hind legs, much longer than body length.
- **Habits and Habitat:** Outside of breeding season, red-legged frog spends time in forested areas next to streams. Breeding occurs in January and February for only one or two weeks. Breeds in marshes, bogs, ponds or lakes. Male calls from beneath two or three feet of water, making an "uh-uh-uh-uh" sound. Female lays 750 - 1300 eggs in a single large egg mass, about the size of a dinner plate.

Notes...

Northwestern Salamander

- **Description:** Large, brown salamander with prominent grooves or ridges on side of body. Puffy, lighter colored glandular areas behind eyes, along sides and along top of tail. Unlike frog tadpoles, salamander larva have long feathery gills.
- **Habits and Habitat:** Northwestern Salamanders are very common in our area, but are seldom seen. They spend most of their time in underground burrows. Adults may be seen on rainy nights in winter and early spring. When threatened, this salamander closes its eyes, puts its head in a butting position, raises its tail and oozes a sticky white poison from the glands behind its eyes, sides and along tail. The poison may kill small animals such as snakes, shrews or even skunks and raccoons. During February and March females lay firm, grapefruit size, jelly like egg masses containing 40 - 270 eggs. Breeding occurs in wetlands adjacent to lakes, ponds and streams.

Long-Toed Salamander

- **Description:** Long fourth toe of hind foot. Prominent grooves on side of body. Skin is black or brown with a greenish-yellow or yellow stripe along its back and head. The sides, abdomen and chest have white, silver or blue specks. Adults grow to be about 6 1/2 inches long.
- **Habits and Habitat:** Long-toed Salamanders are the most widespread, but also seldom seen. They spend most of the year beneath the surface. They can be found in forests, disturbed pastures, ponds and residential green belts. It is the earliest breeder of all Northwest amphibians, beginning in our area as early as December. Females lay eggs singly or in small, egg-size masses containing 6 - 50 eggs. The masses are attached to vegetation, sticks or rocks. The Long-toed Salamander larva feed on Pacific Chorus frog tadpoles and smaller Long-toed Salamander larvae.

8.1

Source: Amphibians of Washington and Oregon; Seattle Audubon Society

Amazing Facts about King County Amphibians

- Right here in King County we have one of the most poisonous amphibians in the world. It's just as poisonous as the poison dart frog and has the same toxin as the puffer fish. One of them has enough toxin to kill a human, or 25,000 mice. What is it? It's called the Rough-skinned Newt and probably some of you played with it when you were kids. There is not too much danger from picking it up and handling it but, if you do, you should wash your hands afterwards.
- The largest salamander in the world lives in King County. It is called the Pacific Giant Salamander and it can grow as long as 13 inches. The larva can take two complete summers before they metamorphose to adults. When bothered, the adult can yelp and bite and their jaws are powerful enough to eat snakes and small mammals.
- Living on the forest floor of our county, is the dancing salamander Ensatina. The male ensatina dances to get the females attention and tries to get her to follow his "dance steps". If ensatinas are grabbed by the tail, they leave their wiggling tail behind as they dash off to safety. Ensatina don't have the "double life" associated with most amphibians. They spend their entire life on land and are almost never found in perpetually wet areas. They are believed to actually lay their eggs in underground rodent burrows. As with many salamanders, the female attends the nest and broods the eggs over the summer.
- Unfortunately a giant, flesh-eating carnivorous frog resides in King County. This frog devours other amphibians, also reptiles, small mammals and birds, including ducklings. What is it? A bull frog. This giant frog, up to seven inches long, is an introduced species that has been responsible for the disappearance of the spotted frog in the Puget Sound area. It has also affected the population of Western Pond Turtles and has caused the decline of waterfowl populations at the Columbia National Wildlife refuge. They are not native to Western Washington, instead a native to eastern and midwestern United States and southeastern Canada. Bull frogs may have been introduced to the west in biology classes as live specimens, where they were either accidentally or intentionally let go. People moving west, who enjoyed eating large frog legs, are also believed responsible for their introduction.

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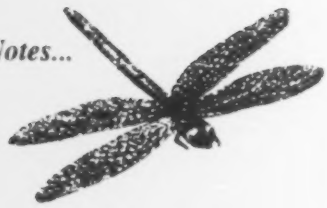


Aquatic Insects

Insects In General

There are more species of insects on our planet than all other organisms combined. Doing more good than harm, we would be unable to live without insects — although they easily could live without us. They pollinate (fertilize) flowering plants, are food for others and are important in decomposing and recycling nutrients.

How Do We Know It's An Insect?

All insects have a segmented body with three parts. A head, with antennae, eyes and mouthparts; a thorax, with three pairs of legs and wings (often); and an abdomen, with organs for mating, breathing and digesting food.

What Is An Exoskeleton?

Insects have a hard outside shell called an *exoskeleton* which supports the insect's body and keeps it from drying out. This is shed as the insect grows and a new exoskeleton is formed. This process is called molting and insects will *molt* many times in their lifecycle.

Metamorphosis

An insect develops from egg to adult by one of two general processes. The first is *simple* or *incomplete metamorphosis*. A *nymph* molts many times until it becomes an adult. This is found in grasshoppers, true bugs, dragonflies and in certain other orders. During these changes the nymph (except for the aquatic offspring of dragonflies, damselflies, mayflies, and stoneflies which are called naiads) looks much like it's adult form only smaller and sometimes without wings.

The other process is called *complete metamorphosis*. The insect passes through four distinct growing stages—the egg, larva, pupa, and adult. The larva is the active feeding stage, while the pupa is an inactive resting stage during which the larva transforms into an adult. This complete metamorphosis occurs in insects such as butterlies, moths, flies, beetles, wasps and bees.

Notes...

Many Insects Live In The Water

1. About half of the 25 major groups of insects live in fresh water. Aquatic insects can be found in almost any body of water, but have different physical needs depending on their habitat. For example, streams have different habitats within their boundaries. Living in a stream, insects have developed ways to attach themselves to rocks or weigh themselves down so they won't be washed downstream. Some aquatic insects prefer fast moving waters and others prefer more calm areas.
2. Many aquatic insects lay their eggs in ponds in the fall: the adults die and the eggs hatch next spring.
3. Some aquatic insects spend their nymph, naiad, or larva stage in the water and emerge out of the water as adults. Many, like mayflies, spend only a few days as adults on land, just long enough to mate and die.

How Have Insects Adapted To Life In Water?

In order to live in the water, insects have adapted various ways to obtain oxygen, which is needed to convert food into energy. Some insects have developed gills (similar to fish) to remove oxygen from water, some have snorkel-like tubes which pierce the water to the outside air and some trap air on their backs under wing covers. This method is used by water boatmen and backswimmers. Because the water bubble keeps them buoyant, these insects must swim hard to stay submerged and cling onto plants to rest.

Some aquatic insects must also adapt to wetlands that dry up during part of the year. Some lay eggs that stay *dormant* until the next rain (for example, mosquitoes), some bury themselves into the mud and return when the rain resumes. Some might move to a new source of water (like diving beetles).

Where Do The Aquatic Insects Live In The Water?

Aquatic insects live at different levels in the water. Waterstriders take advantage of the surface tension of water and skate along the surface, sucking juices out of their prey. Whirligig beetles live on the surface, but have eyes in two parts, one to look into the air and one beneath the surface seeking food. The nymphs, naiads and larvae of most aquatic insects live at the bottom of the ponds and streams.

Notes...

Water Nymphs And Larvae

The following common, immature insects are aquatic. They may not resemble their adult forms and may be mistaken for other insect species. The young of dragonflies, damselflies, mayflies and stoneflies, are known as naiads, and go through simple metamorphosis before changing to adults. The young of mosquitos, midges, black flies, diving beetles, and caddisflies are known as larvae, and have a complete metamorphosis.

- **Mayfly naiads** live in streams and cling to rocks using a claw found on each leg. They also may be seen crawling along the bottom of ponds or even burrowing into the mud. They eat tiny aquatic plants and in turn are eaten by other insects and fish. As the waters warm, hundreds or thousands swarm to the surface, become adults, mate, lay eggs and die within one to two days. Their dead bodies become food for other animals.
- **Stonefly naiads** live under stones and also crawl along the bottom of streams and ponds. Some eat plant debris and algae and some are predators of other insects like mayflies. As adults they leave the water, shed their skin and spend the rest of their life eating and mating.
- **Caddisfly larvae** have developed a unique way to protect themselves by building cases around their bodies. These cases can be made from small pebbles, leaves, plant debris, shells or sand. The cases are tubular, with water flowing through so their gills can obtain oxygen. A hook at the tip of the abdomen holds the larvae in it's house. The case helps weigh the larvae down so it won't flow downstream and also provides camouflage for the larvae. The caddisfly moves around the bottom looking for food. When it's finished growing, it builds a cocoon, by sealing off both ends of the case. After it changes, the Caddisfly chews its case open, goes ashore, sheds its skin and is an adult.
- **Dragonfly naiads** are fierce predators, eating mayfly nymphs, small fish and tadpoles. To grab their prey, they have sharp pinchers located on their lips. When fully grown, naiads emerge from the water. They shed their skin and become adults. As adults, dragonflies are fierce hunters feeding on other insects including mosquitoes, water insects and even young fish!

Why Are Aquatic Insects Important?

The diverse assortment of aquatic insects provides food for fish, turtles, and other wildlife. Aquatic insects are also good indicators of the health of our ponds and streams, and are known as "biological indicators". In polluted waters, some insects are unable to survive. For example, a healthy pond or stream will have an abundant supply of oxygen. If the water becomes polluted with manure, pet wastes or grass clippings, a decrease in the available oxygen for insects and fish can occur. Bacteria will break down or decompose many of these pollutants. When this occurs, oxygen levels in the water become reduced. Also, the external gills of aquatic organisms could be clogged by the various particles in the water.

Insects live most of their lives in one section of a stream (as opposed to moving through the stream as fish do) so the health of a certain section of stream can be determined by the abundance or lack of certain insects.

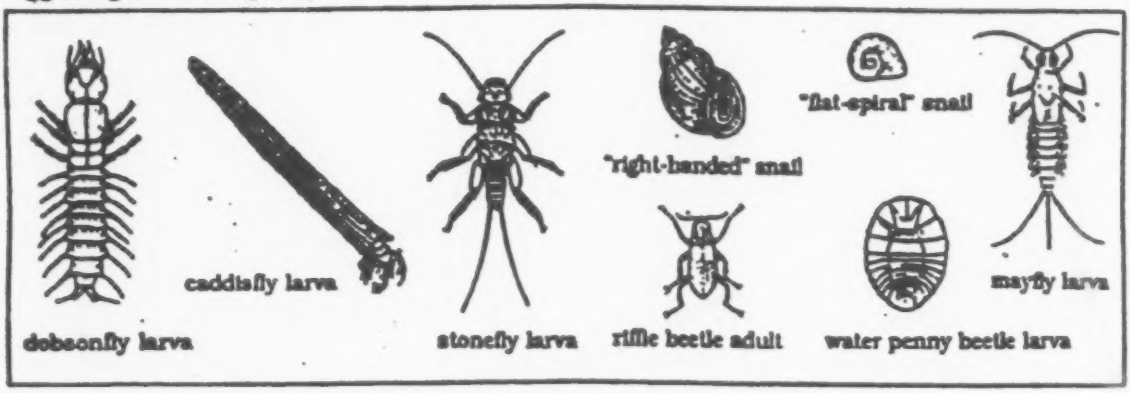
On the next page is a chart showing three groups of aquatic insects and their pollution tolerance levels.

In summary, aquatic insects are very important to a healthy ecosystem. They supply food for fish, birds and other insects. They help decompose leaf and plant debris and they are an indicator to the health of our waters.

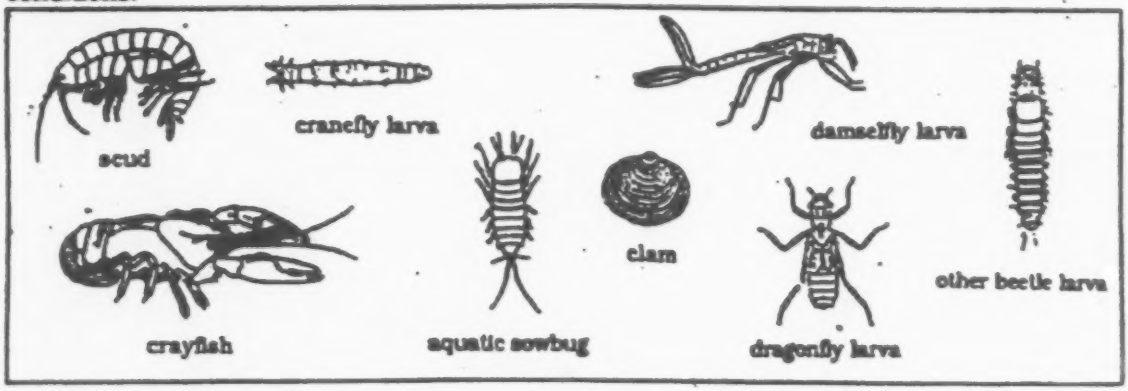
Notes...

MACROINVERTEBRATE TOLERANCE GROUPS

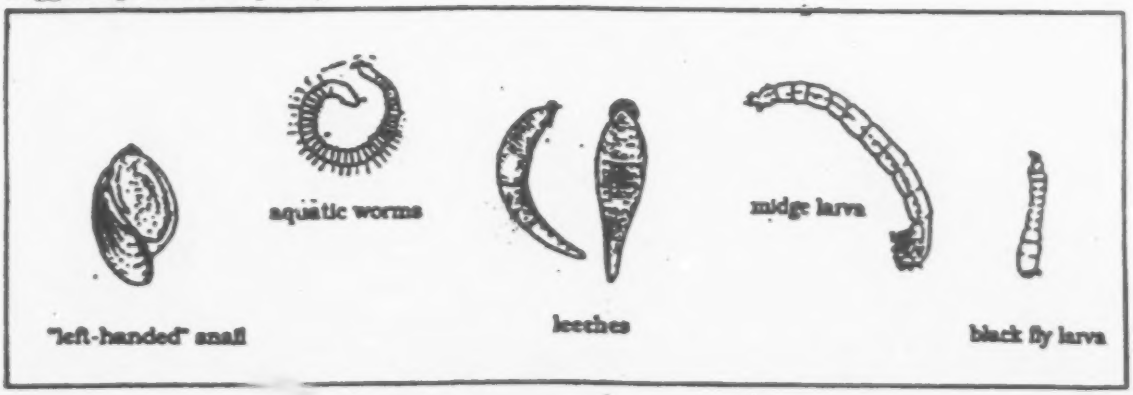
GROUP 1 INTOLERANT. These organisms are sensitive to pollution. Their dominance generally suggests good water quality.



GROUP 2 SOMEWHAT TOLERANT. These organisms can tolerate a wider range of water quality conditions.



GROUP 3 TOLERANT. These organisms are generally tolerant of pollution. Their dominance suggests poor water quality



Fun With Dipnets - Activity

Notes...

OBJECTIVE

Students will be able to identify aquatic insects, by noting the specific adaptations insects have made for life in the water.

BACKGROUND

The best way to understand insects is to explore a stream or pond and find, observe and examine aquatic insects. If collecting from both a stream and pond, compare the differences between the insects.

MATERIALS

dip nets
small plastic containers
eyedroppers
magnifying glasses
dishes or other low sided containers for viewing
white colored pans
white plastic spoons
small jars with tops

PROCEDURE

1. Sweep the dip net through the water or along the bottom of the pond.
2. Bring the net out and hold it upside down over the observing pan.
3. Fill the smaller "backflushing" container with pond water and pour the water through the net in order to wash all the contents of the net into the observing pan.
4. Let the contents of the pan settle down so that the small aquatic creatures may be seen against the light-colored background.
5. Use the spoon or eyedropper for catching sample specimens and put them into the jar to bring back inside for observation.
6. Return the remaining creatures and water in the observing pan to the pond.
7. Repeat the process and see what new creatures may be found.

Some of the creatures may be put into jars for further observation back in the classroom, to be returned later.

Activity Source: Sisson, Edith Nature With Children Of All Ages, Audubon of Massachusetts

Notes...

Freshwater Aquariums - Activity

OBJECTIVE

To be able to identify aquatic insects and understand their basic needs.

BACKGROUND

For a class unable to go to a pond or a stream, a freshwater aquarium can be set up in a class to observe the insects you have collected. Air, light and a biologically balanced community are the main points to consider in managing an aquarium. A low tank with a wide surface area will allow for more aeration than a tall, narrow one. Green plants are excellent oxygen producers in an aquarium. If further aeration is necessary, use an electrical aerator. Light is essential for the health of aquarium plants, but too much light is not beneficial for water creatures accustomed to living in murky waters. To keep a biologically balanced aquarium, consider food chains and the needs of the individual animals. For instance, the highly predacious dragonfly naiads eat almost any other small aquatic creature, even young tadpoles. For help in keeping an aquarium clean, keep some pond snails in it.

MATERIALS:

glass tank soil or gravel

water plants water animals

pond water small plate

PROCEDURE:

Put about 2 1/2 inches of soil on the bottom of the glass tank and plant some aquatic vegetation in it. Lay the small plate on the bottom and carefully pour the pond or tap water (have tap water sit 24 hours to evaporate any chlorine that it may contain) onto the plate to minimize disturbance of the soil and plants. Now add the aquatic creatures.

A good resource book: Habitats, Making Homes for Animals and Plants by Pamela M. Hickman.

Activity Source: Sisson, Edith Nature With Children Of All Ages, Audubon of Massachusetts

Water Striders - Activity

Notes...

BACKGROUND

The darting movement of the water strider is a common sight at many streams, brooks, and ponds. Striders move across the water using their middle legs like oars and by steering with their rear legs. A strider can walk on water because it has long legs covered with tiny hairs that distribute its weight over a large area of water. The surface tension supports striders just as it can support a carefully placed needle. An experiment would be to add a little soap to the water and see if the surface dwelling insects behave any differently. (Soap reduces surface tension.)

Water striders are voracious feeders, eating insects dead or alive and other tiny animals that land on the water's surface. Like all members of the water bug family, striders have long, thin beaks for mouths. The beak is used like a straw to suck body juices from their prey. Striders locate their food both by sight and by their ability to detect the vibrations tiny animals create by struggling to escape from the water.

Striders breed during the spring and early summer. During these seasons water striders are often pursuing other striders and mating. Mating striders look like they are riding "piggy-back".

MATERIALS

sweep nets, clear plastic cup, bug box or magnifying lens.

PROCEDURE

Observe the water striders with your students. Ask your students the following questions:

How many legs do striders have? What parts of their legs do striders place in the water for support? Which legs do the striders move with? Are striders wet or dry? How do striders move in different spots, e.g. in strong currents, sun, shade, the middle versus the edge of the water? Where do striders spend most of their time?

Bait the striders with small insects to observe them eating. Challenge the students to discover how the striders catch and eat their food.

Activity Source: Sisson, Edith Nature With Children Of All Ages, Adubon of Massachusetts

Notes...

Surface Tension Activity Extensions

BACKGROUND

One of the properties of water is surface tension. Water striders take advantage of this by having long legs covered with hundreds of tiny hairs which distribute their weight along the surface. The surface tension of water supports striders just as it can support or carefully placed needle. The following three activities will demonstrate some of the properties of surface tension in water.

Activity #1

MATERIALS:

shallow dish
toothpick
pepper
dishwashing soap

PROCEDURE:

Put water in the dish and sprinkle pepper on the surface. With a toothpick let a small drop of detergent fall into the water. The soap will break the surface tension and the pepper will quickly scatter.

Activity Source: Sisson, Edith Nature With Children Of All Ages, Audubon of Massachusetts

Activity #2

MATERIALS:

Paper clip or needle
paper cup
velvet
pan of water
several pennies

PROCEDURE:

Carefully place the paper clip or needle on the water in the pan. It can float. Look carefully and see the indentation in the surface film where the clip or needle is floating.

Greasing the paper clip or needle may make it easier to float. Water striders, who, as their name suggests, stride on the surface of water, have slightly greasy feet, which helps them stay on top of the water.

There are other ways to show surface tension. Fill a cup with water. Carefully slip pennies into the cup, one by one. The surface tension will allow the water to rise slightly above the edge of the cup.

Push a small piece of velvet under the water. Surface tension will prevent the water from penetrating between the fibers of the velvet, and the layer of air will give the velvet a silvery appearance. Some aquatic animals have hairy coverings that retain air, useful to the animals for breathing.

Activity Source: The Science Club, PO Box 19751 Seattle, WA 98109

Notes...

Activity #3

MATERIALS:

wax paper

pencil

birthday candle with the wick cut off

water

PROCEDURE:

Put drops of water on a piece of wax paper. Observe the drops of water. With the pencil, move a drop of water around; join several drops of water together. Poke a drop with the pointed tip of the birthday candle. Did the candle make a hole in the drop, as did the pencil? Or did the drop seem to have a skin, the surface tension, which the candle could not easily break through? The wax should have had greater difficulty breaking the surface tension for the same reason that the water striders have slightly oily feet.

Activity Source: Sisson, Edith Nature With Children Of All Ages, Audubon of Massachusetts

Notes...

Who Lives There? - Activity

BACKGROUND

In any body of water, you and your children will discover a wide variety of interesting creatures. In a pond you may find toads, turtles, snails, insects, crayfish, or small fish. In a lake you might see larger fish and an assortment of birds, ducks, and geese. Take along a sketch pad and have your children draw their favorite underwater friend. Ask them to discover something about that animal that makes the water the best place for them to live.

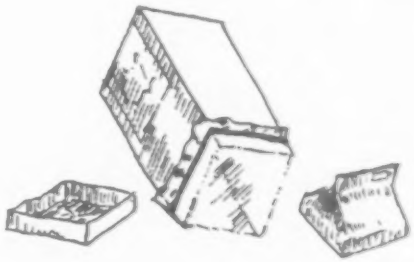
Make an Underwater Viewer - Activity

BACKGROUND

Have you ever tried to open your eyes underwater? Most of what you'll see is a big blur. That's because light behaves differently in water that it does in the air. Our eyes are especially designed to see in the air, but the eyes of fish and other aquatic creatures are designed to see underwater. You and your children can help make your underwater exploration clearer by making a simple viewer out of scraps.

PROCEDURE

Take a clean, empty half-gallon milk carton and cut off the top and bottom. Cover one end with a piece of clear cellophane and secure with a rubber band. For clearer underwater viewing, simply place the plastic covered end into the water and look through the carton. You'll see many things you never noticed before!



Mammals

Many mammals live near or in wetlands and streams, and depend on the lush plant growth for food, shelter and nesting. Sedges, cattails, reeds, willow and alder all make excellent food and nesting material. The abundance of other animal life such as insects, amphibians, fish, shellfish and reptiles also make wetlands a smorgasbord for carnivores, omnivores and insectivores like opossums, otters and bats. Many other animals who do not make their home in wetlands, depend on the wetland animals and plants for their food (owls, raccoons, bear and elk, to name just a few).

What makes a mammal a mammal? Some of the characteristics that are unique to mammals are 1) mammary gland- which produce milk to nurse the young 2) live births- live births are typical, but there are some exceptions like the duck-billed platypus 3) coat of hair- which helps to control their body temperature. Most mammals coats come in shades of brown and gray. No mammal's fur comes in the bright colors that some birds and fish wear. It is much safer for them to have the camouflaging colors. Especially the smaller mammals, like voles, moles and mice, which tend to blend with the ground so they are less visible to predators that hunt from above and in dim light.

Another way some mammals protect themselves is by being nocturnal. This is why we seldom see the mammals we will talk about in this section. But, we can tell they are around from the "signs" they leave. Some of the signs are foot prints, scat, nests or burrows, trails, food scraps or caches, scratch or teeth marks on trees and branches, skeletons and if you're lucky, their calls or sounds.

- **Opossum**

An opossum is about the size of a domestic cat, with a grayish body, white pointed face, black ears and feet and a long naked tail. They are not native to Washington, but were introduced from the eastern United States.

Opossums are the only marsupials or pouched animals living in North American. After only 13 days of pregnancy (the shortest pregnancy of any other North American mammal!) the mother may give birth to as many as 25 young. They are so small at birth that all twenty-five can fit in a teaspoon! The "larval" young make their way up the mothers abdomen to the pouch , where the first thirteen to get there, attach themselves to her thirteen nipples. The remaining young will not live. After 3 months of nursing, about seven of the young will have survived and be ready to leave their mother, after having traveled clinging to her back for several weeks.

Opossums leaf and grass lined dens are located in hollow trees, rock

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piles, under buildings and abandoned burrows of other animals. They are found most often in deciduous growth along streams. Their unique tails are capable of wrapping around branches like a fifth hand, letting them hang upside down.

Opossums are omnivores - eating anything that is available. Their primary diet, in order of preference, is insects, fruits, mammals (carrion and alive), reptiles, grains, birds and bird eggs and garbage.

Signs

- *Foot prints*- distinctive prints, the back foot has a "big toe" which is slanted inward or even backward. The three middle toes are close together.
- *Sound* - a low growl and hissing when disturbed

- **Shrew**

Vagrant Shrew, Water Shrew and Marsh Shrew

Shrews are the smallest of the mammals measuring only 4 - 5 1/2 inches long (including the tail.) They are covered with thick, soft, dark fur except for their nearly hairless tail. They are short lived, seldom living more that one year. They have such high metabolism they must feed almost continuously day and night to stay alive.

Shrews eat a variety of insects, and invertebrates such as worms and occasionally seeds and other plant material. They have been known to eat small mice and other shrews. Shrews eat 1 1/3 times their own weight each day.

One of the main causes of death for a shrew is called "Shrew Shock Syndrome" - they just fall over dead after being captured or exposed to a loud sudden noise. Shrews with their poor hearing and eyesight are not very good at avoiding their predators - owls, stellar jays and trout. The only defense they seem to have against other potential predators is that they simply do not taste good.

The water and mouse shrews are good swimmers and spend a lot of time in the water going after tadpoles, snails and leeches. They are extremely buoyant trapping an air layer next to their skin. If they stop paddling for just a moment, they pop right back up to the surface. On land they spend most of their time in tall grass, under logs and in alder thickets where the ground is moist and muddy.

Signs

- *Nests* - nests found in tall grass and under logs are a round shape made of shredded leaves or other material, even rabbit fur.
- *Owl pellets* - skeletal and fur remains of shrews may be found when dissecting an owl pellet

- **Mole Townsend and Coast Moles**

The largest insectivore with it's black velvety fur grows to between 7 and 8 1/2 inches long. The fur can be easily brushed backward and forward to make it easier to switch directions in it's narrow tunnels. Moles have almost naked snouts and tails and large powerful front feet for digging. The eyes are very small and covered by skin, to keep out dirt and sand. Their exceptional hearing allows them to hear and hunt earthworms digging through the soil.

Both of these local moles live almost entirely underground, building mazes of tunnels and burrows in moist grassy lowlands and river bottoms. The mole uses it's snout to find good places to dig. The front feet reach forward to grab the soil which is pushed sideways and backwards by the moles head and snout. The molehills that you see are the outlets for the soil excavated from the tunnels. You will not find any exit holes in these hills.

Their diet consists mostly of worms, insects, spiders and once in a great while roots and other plant material.

Signs

- *Mounds and tunnels*
- *Scat* - small scat with soil particles and insect skeletons

- **Voles**

Townsend and Longtail Voles

Of the over four thousand species of mammals, almost one thousand seven hundred are rodents and almost one thousand three hundred are mouse-like rodents. Voles, also known as "meadow mice" are distinguishable from mice by their blunter snouts, smaller tails and eyes and almost invisible ears. All voles are herbivores whereas some mice are omnivores. Voles have long brownish gray fur.

These two vole species like to live in low, moist grassy areas near streams, lakes and swamps. They are active both day and night and are good swimmers. Voles like to eat grasses, sedges, seeds, grain and bark. Voles are likely to be eaten by many other mammals, but is a special favorite of the northern harrier. They make their nests either above or below the ground along their surface runways. Some voles will make round summer nests in tangled stems of reeds or cattails over the surface of the water and swim back and forth between the nests.

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Voles will roam as far as a mile from their home. They can live to be three years old, starting to reproduce at only one month old. Some voles have been known to have up to seventeen litters in one year!

Signs

- *Narrow runways* - one to two inch wide trails through matted grasses.
- *Scat* - small piles of brownish droppings and short pieces of grass stems along runways.
- *Burrows* - round openings to the surface of snow. Rope like cores of dirt and grass excavated from the tunnels.
- *Teeth marks* - small tooth marks on twigs and branches

- **Muskrat**

This rodent is about two feet long which includes a long scaly hairless flattened tail (opposite of the beaver's tail.) The muskrat has small eyes and ears and front feet with large webbed hind feet. It has beautiful, thick brown fur which has been sought after by trappers for hundreds of years. Several million muskrats are still trapped every year - more than any other fur bearing animal in the United States. In the south , they are referred to as "marsh rabbits" and are trapped for their meat.

Muskrats make their homes in the freshwater of slow moving streams, marshes, swamps and ponds. In a stream, muskrats will dig burrows in banks. In ponds or marshes, they will build dome-shaped houses extending three to four feet out of the water. The domes are made of mud, cattails and other soft wetland plants. Their homes have several underground entrances leading to a one room chamber with a nest of shredded leaves. A family of six to eight will make this their home. Muskrats have been commonly known to share beaver lodges with their owners.

A muskrat's diet consists mainly of plants such as cattail, rush and water lily, but they also eat mussels, snail and tadpoles. They can take deep breaths and last up to fifteen minutes underwater.

The muskrat gets it's name from a pair of musk glands (scent glands) located on it's lower abdomen. During breeding seasons, both the male and female secrete musk on scent posts made from small grass cuttings.

Signs

- *Conical homes* - heaped up piles of matted vegetation on shore at the water's edge or in the shallow water extending as much as 4 feet above the surface.
- *Tracks* - inner toe of front feet are very small and rarely show. Will only see four toes.
- *Scat* - elongated (5/8 inch long) found in little piles on logs in the water, on rocks or resting places along the bank.

- *Holes* - in dense masses of vegetation where they have dug for roots
- *Scent Posts* - on bank near water, little platforms or mats of cut stems or leaves, sometimes mixed with mud.
- *Rafts* - floating rafts of cut stems. These are resting platforms where they will stop to eat.
- *Floating stems* - neatly clipped sedge and cattail stems floating at the waters edge

- **Beaver**

The most well known of wetland mammals is the beaver. Weighing anywhere from forty to sixty pounds, it is the largest of the North American rodents. Also nocturnal, beavers emerge for work and feeding mainly after sundown.

Like muskrats, beavers will build burrows in the banks of fast moving streams, or lodges built of sticks, logs and mud in ponds and marshes. The entrances to the lodges are under the surface of the water, but the central rooms and nest are above the surface. Streams are often dammed to create a beaver pond which isolates and protects the lodges. The dams also form reservoirs of water where food may be stored beneath the water and saved for later. If the ponds freeze over, the beavers maintain a breathing space beneath the ice by letting a little water through the dam.

Beavers, as herbivores, prefer foods such as the bark and small twigs of aspen, poplar, birch, maple, willow and alder. They are able to chew the bark off the poles underwater without drowning thanks to a water tight closure behind its teeth at the back of the throat.

Family groups of parents and yearlings may live in a den together. They share in defending their territory and repairing the dam. Once the young reach two years old, they are forced out of the den to make a life of their own.

Beaver were almost forced to extinction during the early 19th century when Beaver Hats were all the fashion in Europe. The beaver fur trappers pushed further into the western United States looking for more beaver to meet the growing demand. After the collapse of the fashion, many trappers used their knowledge of the mountains to guide new immigrants and military into the new nation. It's amazing to think that beavers were largely responsible for the exploration of the West.

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Beaver also influence their natural environment. They play an important role in water conservation. Their chains of dams and ponds on a stream distribute runoff during the spring and keep water tables high during the summer. Their ponds create habitat for fish and waterfowl and stimulate re growth of vegetation. Beavers create wetlands.

Signs

- *Tooth marks* - on branches and stumps. Peeled logs and twigs.
- *Slapping sound* - made by the beaver's tail on the water as he/she dives
- *Beaver Dam* - very noticeable dams of sticks, logs, mud and grass across streams and ponds
- *Prints* - distinctive large webbed hind feet
- *Scat* - 1-1 1/4 inch long. Looks like compacted saw dust. Harder to spot, as beaver defecate in the water.
- *Scent mounds* - along shores of pond, piles of mud or mud, grass and sticks. The beaver leaves its scent here to mark it's territory.

- **Otter**

This large (26-30 inches long) weasel-like carnivore is found along larger streams and lake borders. The otter has a rich brown fur, short ears and legs with webbed feet. The tail is thick at the base and narrows at the tip.

The otter den can be either a resting spot under roots or a more permanent den dug into a bank with underwater and outside entrances. The nest is lined with sticks, grass and leaves.

One of the most fun loving mammals, otters spend hours alone or in family groups body sledding down steep banks and body surfing in river rapids. Otter young or pups seem to be afraid of the water at first and have to be taught to swim. Throughout history otters have been thought of as quite "smart." Ancient Chinese fishermen used to train them to herd fish into nets and some European hunters taught them to retrieve waterfowl.

The otters diet consists of crayfish and slow moving fish. They do not seem to be in competition with fishermen for the game fish. Otters also enjoy voles and various amphibians.

Signs

- *Tracks* - sliding troughs into water or down hills. Webbed rear feet.
- *Rolling places* - matted mud, snow or vegetation five to six feet in diameter.
- *Scat* - Left on logs or rocks next to water. Irregular shaped, sometimes flattened mass of fishbones, shells and other undigested matter.
- *Spraints* - scented fecal markers left to mark territory for other otters.

Sources:

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Are You Me - Activity

OBJECTIVE

Students will be able to recognize various young stages of aquatic animals and match them with corresponding adults.

BACKGROUND

Many animals look significantly different in their earliest stages of development, compared to adults. This is obviously true for some aquatic insects. Many aquatic insects undergo metamorphosis. *Metamorphosis* means change during growth. Some insects experience simple metamorphosis while others undergo complete metamorphosis. In simple metamorphosis, the insect egg hatches to produce a *naiad*. Insect naiads have essentially all the features of adults. As they grow, they are visibly similar at each stage.

Insects that experience complete metamorphosis are characterized by eggs that hatch into *larvae*. The larva grows through several stages and then changes into a *pupa*. Pupae are usually encased in a protective cover for their next stage of growth. From the pupae emerge the soft-bodied, often pale-colored insects. They differ remarkably in appearance from their earlier forms, but are not yet completely formed. Gradually the soft pale body develops firmness and color. In complete metamorphosis, there is little resemblance between the adult and earlier forms.

There are also remarkable similarities and differences between other aquatic animals in different life stages. The eggs of many animals hide their eventual form (alligators, turtles, birds). Pelican hatchlings, for example, may be the closest image of miniature dinosaurs to be found currently on the planet. Aquatic mammals, like sea otters, often are easy to recognize. They frequently do not change as dramatically as some other animals in overall appearance as they grow from young to adult stages.

The main purpose of this activity is for students to recognize that there are differences in the life stages of aquatic animals as they grow. The students will increase their appreciation of the diversity of wildlife as well as their understanding of growth and changes in animals.

PROCEDURE

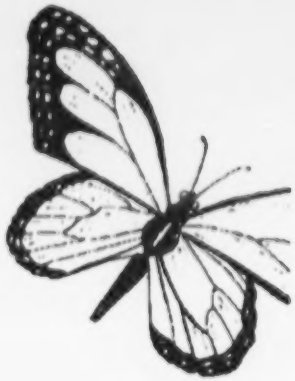
Using picture cards, students match pairs of juvenile and adult aquatic animals.

Activity Source: Project Wild Aquatic, Western Regional Environmental Education Council

Frog

Duck

Butterfly

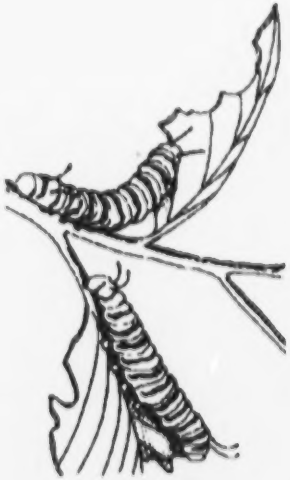


Pelican

Mayfly

Tadpoles

Ducklings



Butterfly Larvae

Pelican Nest and Eggs

Mayfly Nymph

Osprey

Stonefly

Dragonfly

Caddisfly

Whirligig Beetle

Osprey Hatchlings

Stonefly Nymph

Dragonfly Nymph

Caddisfly Larvae

Whirligig Larva

Adult Beaver

Mosquito

Porpoise

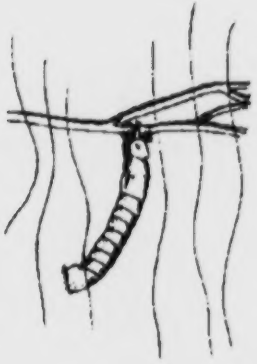
Black Fly

Alligator

Young Beavers

Mosquito Larva

Young Porpoise



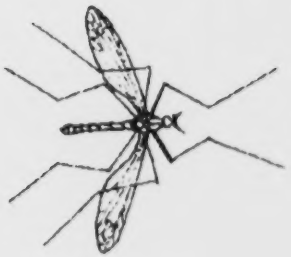
Black Fly Larva

Alligator Hatchlings

Skate

Manatee

Cranefly



Sea Otter

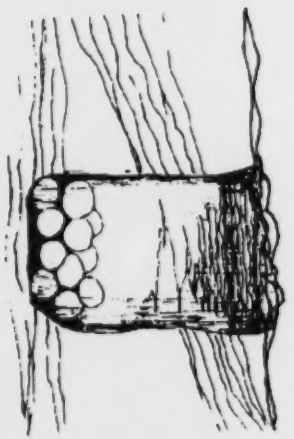
Sea Turtle

Skate Egg Cases

Young Manatee

Cranefly Larva

Young Sea Otters



Sea Turtle Eggs

Notes...

Birds

The types of birds found in wetlands are as diverse as the variety of wetland communities. This section covers many commonly seen birds in King County from the dimunitive Dark-Eye Junco, to the brightly colored American Goldfinch, to the masterful Great Horned Owl.

For Your Information: *The following bird information can be copied onto cardstock and cut for your use.*

American Robin, *Turdus migratorius*

Thrush Family

- **Characteristics:** 9 - 11" long. Puffed out breast is fox red or orange. Juveniles lack the characteristic red breast of adults.
- **Voice:** Sounds like—*cheer-up, cheerily*. Many consider the rich caroling of the male as the true herald of spring.
- **Habitat:** Perhaps the best known of all North American birds', a generalist. Commonly found in forests, woodland, gardens or parks.
- **Food:** Forages on ground for earth worms, grubs and adult insects; also eats berries and other fruits, especially in the winter.
- **Nest:** Nests in shrubs, buildings and occasionally on the ground.
- **Comments:** One of the many native birds that was once hunted for food in the mid 1800's. American Robin is one of the few birds observed to use tools. Seen using twigs as tools to sweep away leaves. Life span: 13 years.

American Goldfinch, *Carduelis tristis*

Sparrow family

- **Characteristics:** Length 5". Breeding adult male is bright yellow with black cap; female is duller overall, olive above. Black wings and tail.
- **Voice:** Song is a lively series of *trills, twitters, and suee* notes. Distinctive flight call, *per-chik-o-ree.*
- **Habitat:** Commonly found in open second-growth woodlands, weedy fields; especially among thistles and sunflowers.
- **Food:** Goldfinches have long tweezer-like bills for probing into thistles, sunflowers and other composite plants. They are the only species able to eat the seeds of teasle, which lie at the bottom of long-spiked tubes.
- **Nest:** Built mainly of grass or moss. Usually in a tree or bush.
- **Comments:** Washington State bird. Widely known as a "wild canary". How a bird moves can be an important clue to it's identity. The roller-coaster flight of the American goldfinch helps you to identify it at a distance.

American Crow, *Corvus brachyrhynchos*

- **Characteristics:** Length 17 ½". Our largest crow. Black bird with long, heavy bill.
- **Voice:** Adult crow has familiar "*caw*" call.
- **Habitat:** Common in a variety of habitats; riparian woodland, tidal flats, farmlands and orchards.
- **Food:** Insects, invertebrates, bird eggs, nestlings, crops. Seen as a nuisance bird, because of damage to crops, poultry, game and songbirds.
- **Nest:** In trees or shrubs. Line nests with shredded bark, moss, grass, feathers, hair, leaves.
- **Comments:** May have winter roosts up to hundreds of thousands. In many birds, eye color changes as the bird matures, and can serve as a means of determining an individual birds' age. American Crows change eye color from blue-gray to brown. This eye color change may help birds to assess the maturity of potential mates. May live up to 14 years.

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Barn Swallow, *Hirundo rustica*

- **Characteristics:** Length 6 ¾". Long, deeply forked tail. Throat is reddish-brown; underparts usually cinnamon or buffy.
- **Voice:**
- **Habitat:** Open country, near water, agricultural areas.
- **Food:** Insects, occasionally berries, seeds.
- **Nest:** Usually made of mud pellets and straw and heavily lined with feathers. In pairs or small colonies, generally nests on or inside farm buildings, under bridges, and inside culverts. Barn swallows tend to return to the same colony sites, and often to the same nest sites within the colony.
- **Comments:** Like many other swallows, Barn Swallows feed in colonies because of their feeding needs: where one finds food, there is usually enough for all. Also when feeding communally, these birds can more readily defend themselves against predators, such as hawks.

Black-capped Chickadee, *Parus atricapillus*

Tit family

- **Characteristics:** Length 5 ¼". Black cap and bib and white cheeks readily identify this small bird.
- **Voice:** Call is a low, slow *chick-a-dee-dee-dee*, song a clear, whistled *fee-bee* or *fee-bee-ee*.
- **Habitat:** Open woodlands, clearings, suburbs.
- **Food:** Usually forages in thickets, and the low branches of trees for insects, seeds and berries.
- **Nest:** In small, excavated tree holes.
- **Comments:** Vocal, gregarious small bird, commonly seen at bird feeders.

Canada Goose - *Branta canadensis*

- **Characteristics:** Length 25" - 45". Our most common and familiar goose. Black head and neck marked with distinctive white "chin strap" stretching from ear to ear. Brown body.
- **Voice:** Among the most vocal of North America's wild birds. Uses their loud, two-note *ha - RONK!* to maintain contact with other flock members and to warn of danger.
- **Habitat:** Freshwater and brackish marshes, meadows, grassy areas, fields, small islands.
- **Food:** Shoots, roots, and seeds of grass and sedges, bulbs, grain, berries; also insects, crustaceans, mollusks. Mostly grain and foliage in winter. "Sentinels" guard foraging flocks.
- **Nests:** Usually near water, made of dry grass, moss, aquatic vegetation. Lined with down during incubation period.
- **Comments:** Color of goose's breastbone, thought to predict the severity of the upcoming winter. Have become a nuisance bird in some areas, as are now year round residents instead of seasonal visitors. People are encouraged not to feed. Because of high numbers in some areas, contribute to poor water quality.

Dark-Eyed Junco, *Junco hyemalis*

(Many species, five sub-species occur in the West)

- **Characteristics:** Length - 6 1/4". Variable color: most forms have a gray or brown head and breast, with a white belly.
- **Voice:** Song is a musical trill, on one pitch, often heard in winter. Members of flock may spread out widely, keeping contact by constantly giving call notes, a *tsick* or *tchet*. Also gives a soft, buzzy *trill* in flight.
- **Habitat:** Ground dweller. Breed in coniferous or mixed woodlands. In migration and winter, found in a variety of habitats. Winters mostly in the eastern US. Tend to winter at same spot every year, and at night, often return to roost at the same place.
- **Food:** Insects, spiders, a wide variety of seeds. Nestlings fed 100% insects, initially partially regurgitated.
- **Nest:** Usually near upturned tree roots, under shrubs or brush piles. Rarely in conifers.
- **Comments:** Highly territorial bird. Males establish territory by arriving in their breeding grounds ahead of females, and begin singing from tall trees. Territory is usually 2-3 acres.

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European Starling, *Sturnus vulgaris*

- **Characteristics:** Length 8½". Chunky, dark, speckled bird.
- **Voice:** Varied note calls including squeaks, warbles, chirps, and twittering. May also mimic other animal sounds, including human voices. Starlings are related to the Hill Myna bird which can mimic human speech.
- **Habitat:** Abundant in a variety of habitats.
- **Food:** Most eat fruit, insects (cranefly larvae), also seeds, nectar and pollen. Also eats crops, germinating wheat, and cattle food.
- **Nest:** Gregarious, roost communally. Mostly in holes, trees, cliffs, buildings. Presence known by humans, because of their ceaseless calling and squabbling.
- **Comments:** Introduced to North America from Europe. About 100 individuals were released in 1890, and today is one of the most numerous birds in America, numbering hundreds of millions. Out competes native birds. In cities, flocks can be over a million birds.

Great Blue Heron, *Ardea herodias*

- **Characteristics:** Length - 46", width 72". Large, gray-blue heron, black stripe extends above eye.
- **Voice:** Hoarse, guttural squawk.
- **Habitat:** Frequently seen at lakes, ponds, rivers and marshes.
- **Food:** Mostly fish, but opportunistic, including human food scraps, nestlings, small mammals, reptiles and amphibians.
- **Nest:** In colonies with other Great Blue Herons and other species of herons. Often nests in tall trees, usually in the top, vertical branches. Often select trees in islands, or trees surrounded by water, as added protection from predators such as raccoons. Rockeries may be used for decades. In the winter, may join others at a communal roost, flying there each night and then flying away daily to favored feeding sites.
- **Comments:** Often mistakenly called a crane. However cranes always fly with neck and head straight out in front. Great Blues fly with necks folded. Was called "Our Grandfather" by the Nisqually Indians. Turkey vultures are known to force nestling Great Blue Herons to regurgitate their last meal, which is later fed to the vultures own chicks.

Great Horned Owl, *Bubo virginianus*

- **Characteristics:** Length - 18" - 25". Largest of our common owls. Ear tufts set wide apart, yellow eyes. Mottled gray-brown above with fine dark, gray horizonal barring below.
- **Voice:** A deeply, resonant hooting, *hoo, hoo-hoo-hoo-hoo*; also three hoots.
- **Habitat:** Varies from forest, to city to open desert.
- **Food:** Predates on medium to large mammals (rabbits, rodents) as well as other birds such as osprey, great blue herons, crows, ducks and even other owls. A favorite food is skunk.
- **Nest:** Doesn't build own, instead may use old nests of hawks, eagles, crows, herons or squirrels. Especially like Red-Tailed Hawk nests, as owls nest well before hawks.
- **Comment:** Since owls can see in the dark, they were believed to possess supernatural powers. Territorial.

Killdeer, *Charadrius vociferus*

- **Characteristics:** Length 10½". Has distinctive double, breast bands. Its' "disruptive" coloration provides camouflage.
- **Voice:** Piercing call: *kill-dee* or *dee-dee-dee*.
- **Habitat:** Common in meadows, farm fields, lawns; also in shores and river banks. Have adapted to urban sites, especially roof tops. Winters in Central or South America.
- **Food:** Mainly insects: mosquito larva, grasshoppers, ants, ticks, bugs, cutworms.
- **Nest:** On open ground, using camouflaging stones, gravel, pebbles. Incubating adults belly soak (wet feathers of their bellies) to cool eggs in hotter part of the range. Have kept eggs cool this way in temperatures up to 134°.
- **Comments:** Adults perform conspicuous broken-wing distraction display.

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Mallard, *Anas platyrhynchos*

- **Characteristics:** Length - 23". Best known duck in America and Europe. Ancestor of almost all barnyard ducks. Male readily identified by metallic green head and neck, yellow bill, narrow white collar, chestnut breast. Female has a mottled coloration.
- **Voice:** Female quacks, male has a hoarse croak.
- **Habitat:** Widespread in most water environments.
- **Food:** Uses broad bill and enlarged tongue to filter feed on aquatic plants, seeds and snails.
- **Nest:** Usually near water, in grasses, reeds or leaves. Line nests with down. Seasonally monogamous; switch mates each year. Male deserts female after first week on incubation to join male flocks.
- **Comments:** Courtship display may allow female to observe the performance of males, and evaluate them as potential mates. Analysis of trace elements (especially metals) in flight feathers, can be used to identify geographic origin of bird.

Northern Flicker, *Colaptes auratus*

- **Characteristics:** Length - 12½ - 14". A large woodpecker. Barred cinnamon brown back and white rump. Head brown, with a gray face and throat and red moustache (male only). Occurs in three color variants: the Red-Shafted of the west; the Gilded and the Yellow Shafted.
- **Voice:** A piercing *keee-ai*. Also *flika-flika-flika*.
- **Habitat:** Deciduous or mixed woods, edge.
- **Food:** Feed on ants, including thatch ants, other ground insects, and in the winter, berries.
- **Nest:** Prefers snags, will use a variety of cavities: poles, posts, houses, boxes.
- **Comments:** Flickers are important in the woodland community, as they provide nesting cavities for many hole-nesting birds. Most territorial of North American woodpeckers.

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Red-Tailed Hawk, *Buteo jamaicensis*

- **Characteristics:** Length 22", width 50". Our most common buteo, also one of the largest. Plumage extremely variable. Has reddish uppertail, paler red undertail.
- **Voice:** Call is a harsh, descending *keeeeer or kloo-eek* call.
- **Habitat:** Variable: woods with nearby open land; also plains, desert.
- **Food:** 85% rodents; also amphibians, crayfish, fish and offal.
- **Nest:** May reuse old squirrel nest, hawk nest or build a new one. Nest throughout King County, most common at low elevations, near open country. When nesting, easily disturbed. Pairs of red-tails can remain together for years, in the same territory. If one of the pair dies, another hawk will acquire the mate and the territory. Watch for courtship and territorial aerial acrobatics in late winter and early spring. Territory is usually 1.5 miles.
- **Comments:** Soar to locate prey, and also to survey their territory to locate any intruding hawks. Soaring occurs most on clear days when the sun warms the earth and creates "thermals" which the hawks use for lift.

Red-winged Blackbird, *Agelaius phoeniceus*

- **Characteristics:** Length 8¾". Glossy black male has red shoulder patches broadly tipped with buffy-yellow. Females are dark brown above, heavily streaked below.
- **Voice:** A liquid, gurgling *konk-la-reee,* ending in a trill. Most common call is a chack note. After first season each year, includes new songs in broad niche repertoire.
- **Habitat:** Abundant bird, found in freshwater marshes, sloughs, dry fields; forages in surrounding fields, orchards, woodlands.
- **Food:** Seeds, insects. Many omnivorous birds like Red-winged Blackbirds increase the proportion of protein-rich animal foods during breeding seasons. Feed young mainly insects.
- **Nest:** In cattails, or other emergent vegetation. Weaves nest out of sedges, grasses, lined with fine grass, rushes.
- **Comments:** Its' conspicuous, labored flight exaggerates the blackbirds' red shoulder patches. When experimenters applied black dye on the "epaulets", this was found to affect the ability of males to attract mates and to territories. 60% lost their territories.

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Rufus Hummingbird, *Selasphorus rufus*

- **Characteristics:** Length - 3½". (Hummingbirds are the smallest of all birds—largest is 8½" long, and the smallest is 2" long, the bee hummingbird). Male: reddish brown/black with a white breast, and metallic copper throat. Female: green back, dull white underparts, sometimes a few coppery feathers on throat.
- **Voice:** Low chipping/buzzy notes. An exciting *zeee-chuppily-chup* is often heard. The wings of adult males may produce a musical buzz in flight.
- **Habitat:** Western U.S. forest edges, coniferous/deciduous forest, woodlands. The sexes have separate territories. The female visits the male at mating time.
- **Food:** Main food source nectar, also supplements diet with tiny insects like flies or gnats.
- **Nest:** Size of a doll's tea cup, made mainly of cobwebs. Each hummingbird species makes it's own special type of nests. Sometimes there are lichens, leaves and even animal fur added.
- **Comments:** Known as "flying jewels" because their feathers glitter like polished gems. Because of an unusual arrangement of fused wing bones, flexible joints and powerful chest muscles, hummingbirds are the only bird that can hover and fly backward. They even fly upside down. If a female is disturbed when feeding, she gives a "no trespassing" signal by fanning and waving her tail. Females therefore have developed distinct tail patterns, whereas males, facing their opponent, signal with their brilliant throat patches, called "gorgets".

Stellar Jay, *Cyanocitta stelleri*

- **Characteristics:** Length 12 - 13½". Front half of bird sooty black, rear dark, bluish gray. Only one of three land birds in our region that have crests (other two are the Pileated Woodpecker and the Cedar Waxwing).
- **Voice:** A *shaak shack* or *chook chook chook.* Scream strongly resembles a Red-tailed Hawk.
- **Habitat:** Prefers dense coniferous forests. In the fall, moves to lower elevations.
- **Food:** Wild fruit, slugs, beetles, grasshoppers, nuts, bird eggs, nestlings. In December-January 90 - 99% of diet acorns or pine seeds.
- **Comments:** Named for the German naturalist, George Stellar, who accompanied Vitus Bering on the trip to the area which is now known as the Bering Strait.

Sources: Birds by Paul Ehrlich, David Dobken, and Darryl Wheye
The Birders Handbook. A Field Guide to the Natural History of North America
Birding in Seattle and King County Site Guide and Annotated List, by Eugene S. Hunn
Field Guide to Birds of North America, National Geographic Society
Stokes Nature Guides: A Guide to Bird Behavior Volume III
Hummingbirds: Jewels in the Sky by Esther Quesada Tyrrell
Western Forest, National Audubon Society
Wildlife of the Pacific Northwest, by Margaret McKenny

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Salmon

Many varieties of salmon and trout belong to a family of fishes called the Salmonidae. There are more than 60 members of the salmon family of which 30 or more are found in the United States and Canada.

Native Americans and Salmon

Salmon have always been an important food for the Indians of the Pacific Coast. The Indians say that in old days "swallows and seagulls" heralded the return of the life-giving salmon.

Early explorers were astounded at the number of salmon. One complained the sound of leaping fish kept him awake. All noted the importance of salmon to the Indians.

William Clark, in the journals of his expedition with Meriwether Lewis, wrote of seeing "five ton stacks of dried salmon" in a village near Celilo Falls, on the Columbia River. All along the river, the Indians honored expedition members with gifts of salmon. Some explorers, weary of it, asked instead to consume the villages' dogs.

Salmon sometimes made up as much as 90% of the Indian's diet. The Native Americans boiled, roasted and baked the fresh fish, and smoked, dried and ground it into powder for winter.

Wrapped in fish skin, the dried salmon would keep unspoiled for several years. They were traded to Great Plains tribes in exchange for buffalo robes and to coastal tribes for dried clams and dentallia, the tubular shells that served as money in the Northwest.

Native people realized that salmon returned to and disappeared from their streams at certain times of the year, and elaborate traditions such as the First Salmon Ceremony evolved. This was a yearly ritual in the Northwest for several thousand years, a mindful offering giving thanks to the natural wonder of salmon. A few Native Americans enact it still.

The salmon are often still used in art work and in legends. One legend tells about "the Salmon People". Salmon people lived in large Indian houses under the sea. In their undersea houses, the salmon had bodies which looked like people. Each year, the salmon people put on robes of salmon skin and became fish for Indians to catch. After being caught and eaten, the bodies were returned to the ocean. The bones came back to life as more salmon people.

Have your students imagine and draw what the salmon people may have looked like.

Types of Salmon

Salmon and trout are very streamlined fish. An adipose fin sets them apart from most other fish, and their soft fins make them safe to handle.

In the northwest there are five kinds of Pacific salmon. People call these salmon by different names so it may seem like there are more than five kinds. The steelhead trout is a close cousin to the Pacific salmon species.

Each type of salmon may have many names but they have only one scientific name. Scientific names are used for fish, animals and plants so that even in other countries where animals or plants have different names, everyone understands what the scientific name is. (The scientific name for human is homo sapiens).

The scientific names for the pacific salmon begin with Oncorhynchus which is the genus name. Oncorhynchos means "hook nose" in Greek. The species name follows and is particular to the type of salmon. The species name came from Indian names.

The scientific name follows the common name.

1. Chinook or King Salmon (*Orcorhynchus tshawytscha*) can grow to be the largest of the salmon. They are usually 10 to 50 pounds but can be over 100 pounds, and live up to 5 years. They make spring, summer and fall runs up rivers, usually after two or three years at sea. A prized fish.
2. Coho or silver salmon (*Oncorhynchus kisutch*). These salmon grow to be about 6 to 12 pounds. They live for 3 years, and is a fall run species. Have been transplanted to the Great Lakes and Chile. Used in aquaculture.
3. Sockeye or Red salmon *(Oncorhynchus nerka)*. These salmon grow to be about 5 to 7 pounds. They live for 4 or 5 years. They are called red salmon because their flesh is a bright reddish, orange color. They also turn bright red when they spawn. Sockeye spend one or two winters inland in a lake before heading for sea.
4. Chum or dog salmon (*Orcorhynchus keta*). These salmon are same size as the coho. They live for 3 or 4 years before they are ready to spawn. The reason they are called dog salmon may be because it gets very large teeth in it's upper jaw when it is ready to spawn or because long ago when salmon was very plentiful, this salmon was used to feed dogs. It only stays in fresh water a few days before heading to sea and has fall runs.
5. Humpback or pink salmon (*Oncorhynchus gorbuscha*). Pink salmon are small salmon that live for only 2 years. When they are ready to go up the river and spawn, the male grows a large hump on its back and a hooked nose, hence name "humpback salmon". It runs in late summer and early fall.

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All five species spawn in Washington waters. The following table shows a few major spawning streams and the corresponding variety of fish in each river.

Spawning Area	Dominating Species
Skagit-Samish River System	Pink, chum
Snohomish River System	Pink, chinook, coho
Cedar River	Sockeye
Kitsap Basin	Chum, Coho
Hood Canal Basin	Pink

The Life Cycle of the Salmon

The life cycle of salmon is one of the most interesting in nature. Salmon are anadramous fish, which means that part of their life cycle is spent in fresh water and part is spent in salt water. They are born in fresh water and come back to fresh water to spawn; they mate, lay and fertilize eggs. After the pacific salmon have spawned, they die.

Egg Development: Salmon lay their eggs in cool, clean rivers and streams where they are protected in the underwater gravel. Eggs are ready to hatch in about 50 days at 50 degrees Fahrenheit.

Hatching and Emergence: The developing larva hatches by moving in the egg and with the aid of an enzyme secreted from a hatching gland located on the head of the larva. The young fish hatch in late winter or spring and are called *alevins*. They are very tiny, less than an inch long. During this time, the alevins hide in the gravel, more like worms than little fish. When the yolk sacks (which are attached to their bellies) are used up and disappear, they wiggle out of the gravel and move into deeper water.

The Journey Downstream

Fry: The baby are now called *fry*. Gravity and stream flow guide the fish up into the water. The dark stripes or spots on their sides are called parr marks. These marks help to camouflage or hide the young so they will not be as readily eaten. Bigger fish may eat them, or birds such as the heron and kingfisher. Pollution and human activities can be dangerous to the fry, such as changes in water temperature, or debris in the water . Pollutants in the water may also weaken or kill baby salmon.

As fish need oxygen to survive, chemical pollutants that will use up the oxygen in water may result in there not being enough oxygen for the fish. Another consequence of water pollution is that it promotes the heavy growth of weeds and algae. When these plants die, they decompose and use up the oxygen in the water. Salmon in these waters will not get enough oxygen and may die.

During this time, for added protection, the fry stay together in groups. They grow quickly while feeding on tiny plants and animals. As they get bigger, they eat insects and continue to grow. Some stay in fresh water only months, while others stay a few years before they migrate to the salt water of the sea.

Smolts: (or fingerlings). When the juveniles are ready to leave fresh water and migrate to the sea, they undergo a special process called smolting, and are called *smolts*. Internally their bodies make many changes in preparation for life in the saltwater. Outside, their bodies turn silvery, which helps to hide them. On the journey to estuaries, dams may prove hazardous as well as the numerous predators that love baby fish. For several weeks or months, the smolts stay in estuaries, where they rest, feed and adapt to salt water. Feeding on tiny shrimp, other crustaceans and smaller fish, they may double or triple in size.

Life in the Ocean

Ocean Salmon: Salmon migrate to the ocean to feed and will live in the North Pacific ocean for one to five years. How far a salmon travels in the ocean and the direction it goes, can vary. Many salmon travel along with the ocean currents in circular routes. Some wander as far as 4,000 miles from their stream to Alaska over to Siberia, while others stay closer to home. Ocean salmon are favorite food for seals, sea lions and orca whales. In schools, the salmon eat, swim and sleep together. They eat food like herring, needlefish and shrimp, and feast until they are ready to return to the stream where they were born.

Spawners: A biological clock tells the salmon when it's time to return home. Adult salmon leave the ocean after 1 - 5 years. They find their way across the oceans using ocean currents, the stars and the earth's magnetic forces. Salmon travel back to the exact place where they were hatched, no matter how small the stream may be. Scientists think that once the salmon get close to their streams, they smell their way home using a "homing instinct".

The return journey upriver is difficult. Salmon have been known to travel up river 2,000 miles and to clear six foot falls. Returning home, salmon may travel in great numbers called salmon runs. There are many dangers for the

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salmon on its trip upstream. Fishers set nets in the river or fish with poles from the side of the river. Sea lions, seals, eagles, bears and other animals may also catch the salmon. In addition to predators, there may be dams for the salmon to confront. Most dams have fish ladders on the sides, and salmon are "supposed to swim up these ladders". Not all salmon are able to swim up these ladders.

Another hazard for the salmon is if a stream is blocked with logs, branches, or even garbage. Erosion from the sides of the stream banks is another problem. Salmon can not spawn in murky or contaminated streams. Low rainfall can also reduce the level of a stream or wetland, making passage impossible.

During this time salmon quit eating and their bodies change color and shape. The bright silver color of the sockeye salmon becomes a brilliant red with yellow markings. King salmon turn black with green and red stripes. Male salmon grow large hook noses. Male humpback salmon grow humps on their backs. These changes are all part of the mating process for the salmon. To salmon, the bigger hook nose may make it more attractive to a female.

Egg-laying: When the male and female mating pairs reach the place where they were born, the female digs a nest, or *redd* with her tail. The female deposits her eggs, which are about the size of peas and can be from pink to red in color. The male fertilizes the eggs with a milky liquid called *milt*, which is full of sperm. These eggs are covered by the gravel thrown up when the female digs the next nest just a foot or so upstream. Salmon must have clean, pollution free water, clean gravel-bottomed, shaded streams to be able to lay their eggs and to have them survive. The egg laying continues until several thousand eggs are laid. This is the end of the life cycle for the adult salmon. Pacific salmon mate only one time, and soon after they mate, they die.

Their eggs will stay in the nest all winter and hatch in the spring. With the hatching of the baby salmon, so continues the life cycle of the salmon.

How are Wetlands Important for Salmon?

Salmon may live in wetlands for part of their lives or travel through wetlands. Wetlands are also important to salmon because:

- Wetlands act like a sponge to help keep water levels in rivers and streams from being too high or too low for the salmon.
  Wetlands soak up water and then slowly release water to streams and rivers. If it rains a lot, wetlands can prevent flooding that may kill salmon or prevent them from moving upstream. When there is not enough rain, wetlands slowly let out water into rivers and streams to keep water levels up.

- Wetlands act like a filter to reduce pollutants and sediment (soil particles and others) in rivers and streams.
  The pollutants would be harmful to salmon. Sediments from upstream, settle out in slow moving water along with the help of the vegetation growing in the wetland. This prevents the sediments from reaching the streams and rivers downstream from the wetland.
- Wetlands produce food for salmon.
  Wetlands are very rich in life, including plankton, insects and small fish. Salmon may use these foods to survive.
- Wetlands provide shelter.

The grasses in wetlands provide good hiding places for the fry to protect themselves from predators.

Wild Versus Hatchery

What is a wild salmon? What is a hatchery salmon? What is a farm-raised salmon?

Wild salmon are salmon that go through the life cycle earlier described. The eggs are laid in streams and rivers and the salmon grow without human assistance.

Salmon are also be raised in hatcheries, which is like a salmon factory. When salmon are born in a hatchery, they return to the hatchery to spawn. As the mature salmon return to the hatchery, their eggs and sperm are removed, the eggs are fertilized, and raised in trays at the hatchery. When the fry emerge from the eggs, they are kept in large tanks, and when they are ready to go to the ocean, the hatchery releases the large amounts of baby salmon.

Salmon are also raised in "farms". Fish farm owners buy baby salmon from the hatchery. The salmon are then raised in "cages" in the water. When they are the right size to eat, they are harvested and sold to fish markets.

Where Does the Salmon in the Store Come From?

The fish may come from commercial fishers. Fishers catch salmon in the ocean, in Puget Sound and in the rivers. Fishers who use nets to catch salmon are called seiners or gillnetters. Fishers who use hooks are called trollers.

Many salmon sold at the grocery store are also from fish farms. Fish farmers are able to harvest salmon all year long.

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Tell The Age of a Fish - Activity

OBJECTIVE
To discover the age of a fish.

Next time you're having fish for dinner, figure out how old the fish was. Or find a dead fish on the beach. A live fish just won't stay around long enough for you to study.

MATERIALS
Fish scales, a magnifying glass.

PROCEDURE
1. Study the fish scales with the magnifying glass. If you can study more than one kind of fish, you'll see that the design on each kind is different.
2. On each scale, look for a pattern. You'll see wide, light-colored bands, along with narrow dark-colored bands. The wide, light bands show the growth of the fish during each summer of it's life. The narrow, dark bands show the growth during each winter of its life.
3. To find the age of the fish, just count the sets of dark and light bands.

IN THIS ONE WAY, FISH GROW LIKE TREES. THEY ADD MARKS OF THEIR OWN GROWTH EVERY SEASON.

VARIATION

Count How Old A Tree Is - Activity

OBJECTIVE
Use this activity along with fish scale activity to show a comparison of living things.

PROCEDURE
Count the age of a tree, and determine what sort of growth season the tree had each year.

1. Look at the stump of a tree. Or find a place on a live tree where a branch has fallen off or been cut off.
2. Count the rings in the wood. Now you know the age of the tree or the age of the branch. (The branch is probably a lot younger than the tree.)
3. Notice how wide each ring is. A wide ring means that the tree had a

good growing season, with enough sunshine and plenty of rain. A narrow ring shows a hard year.

4. What was happening in the world when the tree began its life? Can you think of any events in history that took place as the tree grew?

Did you know that trees can live longer than most any other kind of life? A few of the Giant Sequoia trees in California are more than 2,000 years old. The oldest tree in the world is a Bristlecone Pine in California, believed to be nearly 5,000 years old.

Source: Barron's Science Wizardry for Kids, Margaret Kenda and Phyllis S. Williams

Notes...

Look For Water Pollution - Activity

OBJECTIVE

To be able to detect signs of poor water quality, and to find ways to prevent water pollution.

When you come upon water pollution, your nose often tells you first.

Here are other ways to tell:

1. Look for what ought to be there but isn't. You ought to see lots of fish, birds, and insects around water.
2. Look for trash floating in the water - ugh!
3. Look for green algae. Algae are little plants that spread over the surface of polluted water. Algae can build up as a result of water pollution. They can prevent air from getting into the water. Eventually, nothing else can grow. Algae are the sad sign of a dying body of water.
4. Look for other odd colors besides green in the water. You may not see a business dumping pollutants into the water, but you can see the effect downstream.
5. Look for soapsuds on the water. Huge amounts of detergent can spill into water. Soap gets water dirty, not clean. Soap can kill water plants and animals. And it makes water taste bad.
6. Look for multicolored, shiny spots on the surface of the water. They could be oil.
7. Smell for bad odors, especially the rotten-egg odor of sewage.

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WHAT CAN YOU DO ABOUT WATER POLLUTION? *Carry your own trash away with you. You can even pick up other people's trash.*

If you think major pollution is going on, tell someone. Rivers and lakes have keepers these days, people who work hard to keep pollution away. Or write a letter to the editor of a local newspaper. Other people ought to know that you're concerned.

Source: Barron's Science Wizardry for Kids, Margaret Kenda and Phyllis S. Williams

Hooks and Ladders - Activity

OBJECTIVES

Students will be able to: 1) recognize that some fish migrate as part of their life cycle; 2) identify the stages of the life cycle of one kind of fish; 3) describe limiting factors affecting Pacific salmon as they complete their life cycle; and 4) generalize that limiting factors affect all populations of animals.

METHOD

Students simulate Pacific salmon and the hazards faced by salmon in an activity portraying the life cycle of these aquatic creatures.

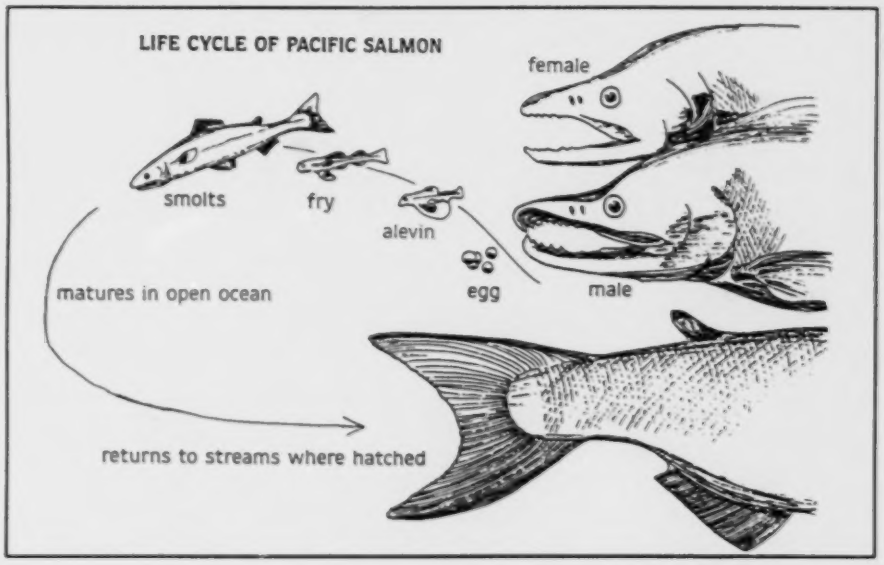
BACKGROUND

Many fish live part of their lives in one habitat and then migrate to another habitat. Some make the migratory journeys to mature and reproduce. Pacific salmon are an example of one of the most spectacular of the migrating species.

Pacific salmon are destined to spawn only once in their lifetime. Within their genetic fiber is an encoded instinct that drives them from the time of hatching along a monumental journey from their freshwater spawning beds downstream into the sea. Once in the sea they spend several years reaching the maturity needed for their single return journey to their original hatching ground. Once there, the salmon spawn and die. Salmon must face a myriad of hazards that serve as limiting factors in the completion of their life cycle. Limiting factors are factors that reduce the populations of living organisms. Sometimes the limiting factors are natural and sometimes they result from human intervention with natural systems.

The female Pacific salmon deposits 1,500 to 7,000 eggs in her freshwater spawn. The eggs are deposited in a shallow gravel depression scooped out by the female. Once deposited, the eggs are fertilized by the male and

then both fish nudge the gravel back over the eggs to offer as much protection as possible. Within a few days both the male and female salmon have completed their reproduction and soon die.



The eggs, before and after hatching, are susceptible to many limiting factors. Smothering silt can be washed in suddenly from watersheds damaged by a variety of land-use practices and events-including erosion following some road building, logging, and fires. Predators can eat some of the eggs and damage hatching populations. Dropping water levels can isolate salmon offspring in streamside depressions to remain isolated and die. After hatching, the small fish-called "alevins"-spend their first two weeks hiding in the gravel. Gradually they absorb their yolk sac and become known as "fry". If they survive the first two weeks, they then begin their journeys. Some head directly to the sea.

Depending on the species, young salmon may spend several months to as much as a year or more in the river before migrating to the estuary and then to the open ocean.

The small ocean-bound salmon, now called "smolts," are at once confronted by hazards on their downstream journey. Examples are dams; low water in streams; and predatory birds, mammals, and larger fish. Up to 90% of the salmon that hatch never reach the sea.

When in the ocean, the salmon grow rapidly by feeding on the ocean's rich food supply. Predators such as sharks, killer whales, and other marine mammals take their toll. In addition, humans fish for salmon commercially and for personal reasons, including food and recreation.

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In two to five years, the Pacific salmon start the journey that will guide them back to the rivers and streams leading to their own hatching site. The upstream migration from the ocean is also a series of hazards. For example, dams hinder their journey and would block it completely if fish ladders were not installed. Fish ladders are water-filled staircases that allow the migrating fish to swim upstream, around the dam. Humans who fish, eagles, bears, and other predatory mammals also reduce the numbers along the way to the spawning ground. Sometimes landslides and logjams provide unexpected new barriers. So too do the natural waterfalls and rapids that the now weighty salmon must overcome. Once back at the spawning ground the life cycle of the Pacific salmon begins anew. To maintain the Pacific salmon population, some biologists believe that only one pair of fish from each spawn must return to deposit and fertilize eggs.

All possible conditions are not covered by the design of this activity. However, the activity does serve simply and effectively to illustrate three important concepts-life cycle, migration, and limiting factors.

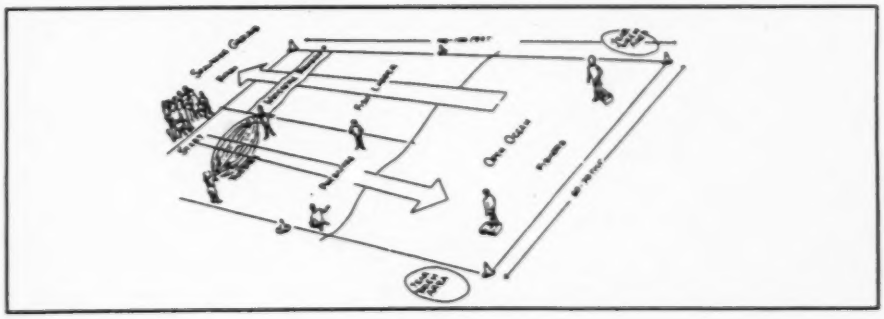
The major purpose of this activity is for students to gain an understanding of some of the complex characteristics of the life cycle of one representative aquatic species, the Pacific salmon.

MATERIALS

Large playing area (100 feet x 50 feet); about 500 feet of rope, string, or six traffic cones for marking boundaries (masking tape may be used if area is indoors); two cardboard boxes; 100 tokens (3 x 5 cards, poker chips, etc).

PROCEDURE

1. Begin by asking the students what they know about the life cycle of fish that live in their area. Do any local fish migrate to spawn? If yes, which ones? (Mullet, shad, lake trout, striped bass, suckers, carp, and salmon are examples of fish that migrate to spawn). In this activity, students will learn about some of the characteristics of one species of fish that migrates as a part of its life cycle-the Pacific salmon.



2. This is a physically-involving activity! Set up a playing field as shown in the diagram, including spawning grounds, downstream, upstream, and ocean. The area must be about 100 feet by 50 feet. Assign roles to each of the students. Some will be salmon, others will be potential hazards to the salmon. Assign the students roles as follows.

- Choose two students to be the turbine team. These are the ones who operate the jump rope which represents the turbines in hydroelectric dams. Later in the simulation, when all the salmon have passed the turbine going downstream, these students move to the upstream side to become the waterfall-broad jump monitors. (see diagram).
- Choose two students to be predatory wildlife. At the start of the simulation the predators will be below the turbines where they catch salmon headed downstream. Later in the activity when all the salmon are in the sea, these same two predators will patrol the area above the "broad jump" waterfalls. There they will feed on salmon just before they enter the spawning ground. (see diagram).
- Choose two students to be humans in fishing boats catching salmon in the open ocean. These students in the fishing boats must keep one foot in a cardboard box to reduce their speed and maneuverability.
- All remaining students are salmon.

***PLEASE NOTE:** These figures are based on a class size of 25 to 30. If the group is larger or smaller, adjust the number of people who are fishing and predatory wild animals accordingly.*

3. Begin the activity with all the salmon in the spawning ground. The salmon then start their journey downstream. The first major hazard is the turbines at the dam. At most dams there are escape weirs to guide migrating salmon past the turbines. The student salmon **cannot go around** the jump rope swingers, but they **can slip under** the swingers' arms if they do not get touched while doing so. A salmon dies if it is hit by the turbine (jump rope). The turbine operators may change the speed at which they swing the jump rope. NOTE: Any salmon that "dies" at any time in this activity must immediately become part of the fish ladder. The student is no longer a fish, but becomes part of the physical structure of the human-made ladders now used by migrating salmon to get past barriers such as dams. The students who are the fish ladder kneel on the ground as shown below, a body-wide space between them.

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4. Once past the turbines, the salmon must get past some predatory wildlife. The predators below the turbine must catch the salmon **with both hands** - tagging isn't enough. Dead salmon are escorted by the predator to become part of the fish ladder. NOTE: Later, the salmon who survive life in the open ocean will use the structure of the fish ladder-by passing through it-to return to the spawning ground. NOTE: Both the predatory wildlife in the last downstream area and the people fishing in the open ocean must take dead salmon to the fish ladder site. This gets the predators and fishing boats off the field regularly, helping to provide a more realistic survival ratio.

5. Once in the open ocean, the salmon can be caught by fishing boats. The salmon must move back and forth across the ocean area in order to gather four tokens. Each token represents one year of growth. Once each fish has four tokens (four years' growth), that fish can begin migration upstream. The year tokens can only be picked up one token at a time on each crossing. Remember, the salmon must cross the entire open ocean area to get a token. The "four years" these trips take make the salmon more vulnerable and thus they are more readily caught by the fishing boats. For purposes of this simulation, the impact of this limiting factor creates a more realistic survival ratio in the population before the salmon begin the return migration upstream.

6. Once four of the year tokens are gathered, the salmon can begin upstream. The salmon must walk through the entire pattern of the fish ladder. This enforced trip through the fish ladder gives the students a hint of how restricting and tedious the upstream journey can be. *In the fish ladder, predators may not harm the salmon.*

7. Once through the ladder, the salmon faces the broad jump waterfall. The waterfall represents one of the natural barriers the salmon must face going upstream. Be sure the jumping distance is challenging but realistic. The two former turbine students will monitor the jump. The salmon must jump the entire breadth of the waterfall to be able to continue. If the salmon fails to make the jump, then it must return to the **bottom of the fish ladder** and come through again. NOTE: When playing indoors, the broad jump waterfall may be changed into a stepping stone jump defined by masking tape squares for safety on hard floors.

8. Above the falls, the two predators who started the simulation as the predators below the turbines are now the last set of limiting factors faced by the salmon. They represent bears-one example of predatory wildlife. Again, remember that the predators must catch the salmon with both hands. If they do catch a salmon, they must then take the student they caught to become part of the structure of the fish ladder.

9. The activity ends when all the salmon are gone before the spawning ground is reached-or when all surviving salmon reach the spawning ground.
10. Next engage the students in a discussion. Explore topics such as:
    - the apparent survival-mortality ratio of salmon
    - the students' feeling throughout the activity
    - the role of the barriers
    - the role of the predatory wildlife and the people fishing
    - where the losses were greatest
    - where the losses were least
    - what the consequences would be if **all** the eggs deposited made the journey successfully
    - what seemed realistic about this simulation and what did not
11. Ask the students to summarize what they have learned about the life cycle of salmon, the salmon's migration, and limiting factors that affect salmon. Make sure the students have a clear working definition of limiting factors. Encourage the students to make the generalization that all animals-not just Pacific salmon-are affected by limiting factors. Ask the students to give five examples. They might mention availability of suitable food, water, shelter, and space; disease; weather; predation; and changes in land use as well as other human activities.

Notes...

EXTENSIONS

1. Write a report on the life history of one of the species of salmon (e.g., chinook or king, chum or dog, pink or humpback, coho or silver, sockeye or red, Atlantic). Create a mural showing the life cycle of this salmon.
2. Research and illustrate the life cycle of any local fish. If possible, look for one that migrates.
3. Compare how the life cycle of a Pacific salmon is similar and different to the life cycle of one or more local fish.
4. Investigate similarities and differences in the migration and life cycles of Atlantic and Pacific salmon. Investigate the life cycle of salmon in the Great Lakes ecosystem.
5. Visit fish hatcheries that work with migratory species and investigate how they function.

Notes...

6. Explore ways that dams can be modified to let fish safely pass downstream and upstream. Design the "perfect" fish ladder.
7. Investigate and discuss **commercial** fishing for salmon. Investigate and discuss **personal**, including recreational, fishing of salmon.
8. Find out about laws protecting migratory species, including fish.
9. Raise salmon eggs in the classroom, and release in your local stream. Call Rich Colt at Volunteer Fisheries Resource Program at (206)902-2260.
10. Have kids identify streams with signs. Call Department of Fisheries Volunteer Resource Program at (206)753-4490 for more information.

EVALUATION

List, describe, and illustrate the major stages in a Pacific salmon's life cycle.

What are some of the factors that affect salmon as they complete their life cycle?

Identify and describe some limiting factors that might affect other animal populations.

Salmon Educational Resources

Dept of Fish and Wildlife, Wa State	Diane Ludwig Aquatic Education (206) 902-2262	Salmon Life Cycle Display Activity book 5 species poster Salmon life cycle poster Habitat poster
Green River Hatchery	Call 931-3950 for information	Tours
Issaquah Hatchery	Call 392-3180 for information	Tours
King County Surface Water Management	Pat Johnson 296-8029	Salmon Olympic Game Posters
Seattle Aquarium	Buzz Shaw 386-4341	Classroom programs at the Aquarium Watershed Wonder Teacher Workshops Get Wet traveling exhibit on Pacific Salmon Grades K-3 Curriculum Grades 4-6 Curriculum

Books available from the King County Public Library System:

TITLE	Author	Call letter	Description
Red Tag Comes Back	Fred Phleger	45401288 ISBN: 0-06-024706-1	An I Can Read Book for young children from Harper & Row. Excellent story for a wide range of ages. Describes all the obstacles the salmon encounter when coming upstream. Good pictures and big type.
The Life Cycle of Salmon Salmon Salmon	Paula Z. Hogan	53756391 ISBN: 0-8172-1255-8	A book with tape for young children. Tape is reading of the text in slow easy to follow format. Covers reproduction well. Story of pink salmon but at end describes some other salmon. The last part of tape covers words that were used in the story. Question card read by narrator.
Ranger Rick, September 1992, pp.18 to 24. Article called Go, Go Sockeyes!	Kathy Walsh	Ranger Rick, September 1992, pp. 18 to 24.	Article on sockeye salmon. Written for preteen to teenager. Has section on Saving the Salmon.
The Bentwood Box	Nan McNutt		Activity book for ages 9-14 with adult teaching guide.
The Great Northwest Nature Factbook	Ann Saling	47429006 ISBN: 0-88240-407-5	A fun book with interesting facts about animals, plants, and areas of the northwest. Could be read by teenagers or parts read by teacher and explained to class.
Native American Animal Stories	Joseph Bruchac	61174439 ISBN: 1-55591-127-7	Many Indian legends including Salmon Boy. This legend may be a little scary for young children.
Puget Sound Handbook	Marine Science Soc. of Pacific NW	Available from Metro	For older elementary students, talks about all aspects of problems with our water quality and how individuals and groups can help.

Notes...

A Wetland Community Food Web - Activity

OBJECTIVE

Understand the interdependence of all life using wetland species as an example.

BACKGROUND

Wildlife in a wetland is an interacting group—no one critter stands alone. Just as in your own community, certain organisms have certain roles. Without everyone doing their job, the wetland community would fall apart.

THE FOOD WEB

The energy for all of lifes activities comes to the earth in the form of sunlight. The light energy from the sun is used by plants to grow, through a process called photosynthesis. In the spring the swarms of tadpoles and insect larvae feed voraciously on the lush new plant growth. But gradually their populations are thinned out by larger predatory animals like dragonfly nymphs, salamanders and small fish. These creatures are then in turn eaten by larger ones like frogs and bigger fish, herons or shrews. The food chain of the wetland grows; with energy being passed from plants, then to *herbivores* (plant eaters) and then on to *carnivores* (meat eaters.) Finally comes the *decomposers* (like bacteria, fungus and worms) that will eat the plants and animals that have died. Even the droppings of all the creatures enrich the water by providing minerals and other raw materials for fresh plant growth. The nutients and energy go around and around being continually recycled.

MATERIALS

large sheets of paper, pencils, crayons, colored pencils, felt pens, rulers

PROCEDURE

In small groups, have your students brainstorm a list of animals which might be found in a wetland. You might remind them that certain organisms may be permanent wetland residents or visitors during certain times of the year. In either situation, these animals are dependent upon wetlands.

Compile a class list of your students' ideas.

At this point you may need to expand on certain groups of animals so that your class list contains all the necessary community members (including plants and small animals such as insects, worms and snails to feed the larger animals). In addition, make sure all the different community roles are covered such as:

predators;	Great blue heron, Northern harrier, frog, salmon, dragonfly naiads
prey;	rodents, ducks, geese, insects, snails, slugs, beavers.
decomposers;	fungi, bacteria, slugs, etc.
producers;	plants

Discuss the idea of a food web which depicts all the interactions between organisms in a community. Explain the necessity of these interactions and how, for example predators ensure the health of an ecosystem.

Introduce the students to the idea that no community can exist without plants. To illustrate this point, challenge them to think of something that they ate at their last meal that was not from a plant either directly or indirectly. Food webs must contain plants.

In their small groups, have your students plan out what they think would be a typical Western Washington food web. You might want to assign the types of wetland community members their webs must include (ex. birds, insects, amphibians, reptiles, fish, mammals). You also might want to assign the community roles to be covered (ex. predators, prey, decomposers, producers). Point out that an individual organism can have multiple roles (a mayfly-eating trout is an insectivore and a predator). Approve each planned out food web before the next part of the lesson.

The students should now draw out their food web using arrows to connect from and to each role.

Gather a few field guides and wildlife encyclopedias to provide pictures of local birds, amphibians, reptiles, fish, insects and mammals. This will help your students during both their planning and drawing stages.

Drawings should be made of the different members of the food web. Each animal should be labelled with the role it plays. Captions may be necessary to explain any action taking place.

The web should eventually cycle back to the plants by way of decomposers. It is this decay of organic matter which fertilizes the plants and makes them even more productive. Wetlands are rich in organic detritus (decomposed matter) and therefore able to support lots of life.

Notes...

Provide your students with large paper to draw their food web on. Colored pencils, crayons, felt pens and rulers will help them create a neat and attractive food web.

FOLLOW-UP QUESTIONS

1. Food webs show interactions between organisms in a community. Explain what would happen to your wetland community if any one member was removed.
2. Little tiny things like bacteria are invisible in your wetland community. Why are they important?
3. Why are wetland plants important?

prey **prey & predator** **predator**

Activity Source: Project Wild Aquatic, Western Regional Environmental Education Council

Don't get too close - Activity

Notes...

OBJECTIVE

Understand space needs of humans and wildlife. Learn habits and needs of wildlife through observation.

BACKGROUND

Once you have completed the "Food Webs" exercise, it is valuable to get out into a wetland to do some observing.

Observations of wildlife should be done in the most unobtrusive way possible. The best way to observe is to simply sit and watch. Before going on a field trip the following activity can be used to stress the importance of this concept.

MATERIALS

paper, pencil, field guides, binoculars

PROCEDURE

Explain to the class that this activity will help them understand how many animals might feel when their habitat becomes crowded by strangers.

Choose one student to join you at the front of the room. Slowly approach the student and ask him/her to let you know as soon as he/she feels their personal space has been entered.

Q: How does this make you feel? Would you feel different if a total stranger had entered your space? Do all your classmates have the same reaction? Why or why not?

Discuss with students the ways in which they respond to this situation (nervousness, sweaty palms, etc.). Are these reactions that you can control?

Put students into groups of 3-4. Provide each group with a paper and pencil and assign one person to be the recorder. Have groups brainstorm on the following:

1. Why might animals feel uncomfortable when approached by a human (what specifically do they fear?)
2. What conditions might cause the animal to be more frightened? Less frightened?
3. List ten local wetland animals that you are likely to encounter on your upcoming observation. Based on the above criteria, how close do you think you can safely approach each one?
4. If you have approached an animal too closely, what might it do to warn you?

Notes...

Select a wetland site to observe and return to that site periodically. By observing at different times of the day over a long period, different behaviors and different members of the wetland community are apparent.

Ideally, observing should be done in pairs in order not to disturb the wildlife.

Comfortable and appropriate clothes and shoes are necessary. Don't forget a notepad and pencil to jot down observations. Helpful but not necessary would be field glasses and field identification guides.

Keep track of what you see, when (time of day and season), and what activities you are observing (foraging, mating, nest-building). Record your data by simply writing it down or by using sketches.

You can hear much of what you cannot see. This certainly is a form of observation. (You can obtain a tape of Washington bird calls from the Peterson Field Guide tapes to help identification.)

You will be amazed at the wildlife you see when you take the time to look. In addition to adding to your knowledge of wetlands, this activity will teach you valuable observation skills that you can use for a lifetime.

Catch That Smell - Activity

Notes...

OBJECTIVE

Students will recognize importance of the senses, especially the sense of smell required for wildlife survival.

BACKGROUND

Many animals depend on their sense of smell to survive. Compared to many of these animals, our sense of smell is not highly developed. For example, could you identify an approaching enemy even if you couldn't see it?

"Catch that smell" is a predator/prey game that will show your kids how to sniff the air for scents. Play the game outside on a nice breezy day.

MATERIALS

A variety of fragrant plants or food items.

PROCEDURE

First, blindfold the "prey" and lead them to the center of the circle. Have the "predators" wait outside the circle, each holding something fragrant (cut onion, sagebrush, peppermint). The predators slowly creep up on the prey. As one of the prey catches a scent, he or she calls out what it is. If the prey identifies one of the predator's scents, that predator must stop in his or her tracks. Once a predator is sniffed out, he or she is out of the game. Did any of the predators survive long enough to catch the prey? Were the successful predators upwind or downwind? Experiment.

Notes...

Exploring Wildlife Habitats - Activity

OBJECTIVE

Ability to distinguish different habitats and understand why certain animals live there.

MATERIALS

paper, pencils, crayons or markers

BACKGROUND

Habitat is another word for an environment or surroundings, or an "animal's" address. There are many animals at your nearby lake or pond and each one lives in a special habitat. They all have the same basic needs: food, water, shelter and space.

PROCEDURE

With your group, explore as many areas of the natural environment as possible. Observe such things as height of trees, the different kinds and sizes of plants, the soil, the lake area, looking for places where animals might live. Select two (2) different habitats and describe each one. Then draw a picture of the type of animal you think would live in each habitat.

Description of Habitat	Kinds of Animals

Activity Source: Field Trip Guide, John Inskeep Environmental Learning Center

Observing Wildlife Habitats And Their Communities - Activity

Notes...

OBJECTIVE

Understand the interdependence of plant and animal communities.

DISCUSSION QUESTIONS

1. Discuss natural communities, plants and animals living together in an area and how they are dependent upon each other for survival.
2. Discuss the things plants and animals need to survive. Compare them with man's needs for survival.
3. Discuss the structure of a community and the role plants and animals have in their environment.

MATERIALS

data sheets (included at the end of this activity), pencils, binoculars, hand lenses

PROCEDURE

Divide your group into teams of three. Each team will receive six data sheets, two for each community: a lake community, an edge community and a densely vegetated community. The data sheets are roughly marked off according to the different heights of vegetation layers in each community. Instruct each team to look for animals and animal evidence (tracks, droppings, burrows, feathers, spider webs, holes, nests, etc.) in each community at different heights. It may be advisable to use hand lenses and binoculars for closer observations. On the first data sheet, students are to draw the animals or animal signs they see at each level. On the second data sheet, they are to write descriptions of each animal observed. (For example, a "bug" is not enough. A red bug with 6 legs, black spots, big as a pencil eraser is a much better description!) Give each team boundaries for each community they work in. Each team should not spend anymore than 20 - 25 minutes in each area. Point out any poisonous plants that may be in the area.

Students will need to get on their hands and knees and gently shake bushes, look under leaves and rocks (remember to return everything to its original position) to find various animals.

Notes...

QUESTIONS FOR DISCUSSION

1. How does the size of the habitat compare with the size of the animal?
2. How does color of the habitat compare with the color of the animal?
3. How are each of these habitats similar? How are they different?

ADVANCED QUESTIONS FOR DISCUSSION

1. In which levels of the community did you find the greatest number of animals? Why?
2. In which level did you find the greatest diversity? Why?
3. How do the following environmental influences effect the animal population at each level?
   a. Temperature changes (seasonal and day to night)
   b. Wind velocity
   c. Moisture availability
   d. Food supply
   e. Cover
4. How would you explain your answer in terms of animal adaptations?
5. Would you expect the same answer in the winter? Why or why not?

Activity Source: Field Trip Guide, John Inskeep Environmental Learning Center

LAKE/ POND COMMUNITY

Draw animal or animal signs you see at each level.

UNDER WATER

ON WATER

ABOVE WATER

Notes...

Notes...

EDGE COMMUNITY

Draw animal or animal signs you see at each level.

GROUND LEVEL

SHRUB LEVEL

TREE LEVEL

DENSELY VEGETATED COMMUNITY

Draw animals or animal signs you see at each level.

GROUND LEVEL

SHRUB LEVEL

TREE LEVEL

Notes...

Tree Holes - Activity

OBJECTIVE

Understand the importance of habitat and the value of dead and dying trees to a variety of animals.

PROCEDURE

Find a hole in a trunk or branches of a tree. Ask yourself, "Is the hole big, medium-size, or little?"

Does it go into the tree, or can I see the end of it?

Is the tree partly dead and hollow?

Is the trunk large enough to shelter a raccoon or squirrel?

Small holes were probably made by insects. Wood-boring beetle larvae live under bark and inside tree trunks. When they become adult beetles, they bore their way out and leave behind small holes.

Small holes that create a pattern on the tree trunk may have been made by a sapsucker. Sapsuckers are woodpeckers that eat insects and tree sap. They make rows of small holes, then fly away. Insects are attracted to the sap and woodpeckers return to feed on them and the sap.

Medium-size holes are probably bird holes. Many woodpeckers make holes for nests. Most species excavate new nest holes each year. Other birds and flying squirrels may use the abandoned holes.

Big holes are probably used as animal homes. Opossum, squirrels and raccoons use holes in the tree's trunk for their dens.

Activity Source: Conejo Recreation and Park District "Naturalist's Guide"

Nature Scavenger Hunt Check - Sheet

NAME_____

DATE_____

THINGS TO SEE

___ A rounded stone (put it back)
___ Moss on SOUTH side of a tree
___ A spider web
___ A cocoon (leave it there)
___ A red and black bird
___ An orange butterfly
___ A bird's nest (don't touch!)
___ A cloud moving
___ A feather tickling
___ An immature aquatic insect

THINGS TO FEEL

___ Rotten wood
___ A mushroom
___ A fuzzy plant
___ A thistle
___ Wet mud
___ A mosquito bite
___ Shade
___ A tree trunk

THINGS TO HEAR

___ A mosquito buzzing
___ Wind blowing through the field
___ Animal jumping into water
___ Chipping sound of a squirrel
___ The call of a Red-winged Blackbird

THINGS HAPPENING TO WATCH FOR

___ An ant carrying something
___ A mushroom growing on a log
___ An animal trail
___ A slug moving slowly
___ A seed traveling
___ An animal swimming
___ An animal eating another one
___ A spider web with a bug on it
___ A plant growing on a rock

THINGS TO SMELL

___ Inside a hollow log
___ A garter snake
___ Crushed green leaves
___ Crushed dry leaves
___ Two kinds of flowers
___ Water in a marsh
___ Damp Soil
___ A wild rose
___ Wild mint

IMPORTANT NOTES

7

Get To Know Your Wetlands

Roll Up Your Sleeves

Contact one of the agencies below to help out with water quality monitoring, storm drain stenciling, wetland restoration, green gardening.....

Adopt - A - Stream Foundation
PO Box 5558
Everett, WA 98206
Tom Murdoch
388-3487
Streamwalks, wetlands, watersheds, storm drain stenciling.

Green (Formerly Called Project Green)
Lisa Bryce Lewis, Northwest Regional Director
522-8489
Student water quality monitoring projects.

King County Conservation District
935 Powell Ave. SW
Renton, WA 98055
Geoff Reed
226-4867
Soil information, small farm management.

King County - Roads and Engineering
Spring Clean-up
900 Administrative Building
Seattle, WA 98104
Jan Kilppert
296-6510
April cleanup. Also on trails, parks, school grounds, rivers, streams.

King County - Surface Water Management
700 Fifth Avenue, Suite 2200
Seattle, WA 98104
Brochures, displays/exhibits
296-1955
Monitoring, revegetation, volunteer projects, streamwalks.

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Metro Hazardous Waste Management Program
130 Nickerson, Suite 100
Seattle, WA 98103
Gail Savina
689-3008
K-12 Educational materials. Monitoring.

Save Lake Sammamish
1420 NW Gilman Blvd., Suite 2565
Issaquah, WA 98027
Joanna Buehler
641-3008
Displays/Exhibits, volunteer projects.

Washington State Department of Ecology
PO Box 47600
Olympia, WA 98054-7600
Rhonda Hunter
407-6147
Wetlands curricula, materials, video environmental education resources.

Washington State Office of Environmental Education
2800 NE 200th
Seattle, WA 98155
Kate Laroque
365-3893
K-12 curricula materials, wetlands, stream, and salmon posters, watershed trading cards.

Washington State Department of Wildlife
Wildlife Education
600 Capital Way N.
Olympia, WA 98501-1091
Margaret Tudor
753-1702
Curricula materials: Project Wild Action Grants, Wildlife Sanctuary Program, Wildlife habitat data collection and monitoring for schools and communities.

YMCA Earth-Corps
14320 Bel-Red Rd.
Bellevue, WA 98007
Anthony Moore
746-9900
Coordinator works with high school students who in turn work with elementary students to monitor water quality and aquatic insects.

Put Your Boots On...

BOTHELL

Kenmore Park (Rhododendron Park) 296-2976 A trail follows the Sammamish Slough through trees and rhododendrons, coming within a hundred feet of the riverine wetlands. The park is located at 68th NE and 170th.

Sammamish River City Park 486-8152 The Sammamish River Park is located on thirty-three acres south of the Sammamish River. The Sammamish River Trail winds through the park's extensive wetlands which provide habitat for abundant wildlife. The trail is located at 102nd Ave. NE and East Riverside Drive. The access to the park is from 102nd Ave., south of the river.

BELLEVUE

Bellefield Nature Park 455-6885 This park on Mercer Slough has both forested wetlands and marsh on a one-mile loop trail. Take I-405 to the SE 8th Street exit in Bellevue. Go west on SE 8th Street. Turn left on 118th Ave. SE. The trailhead is approximately 1/2 mile on the right.

Kelsey Creek Park *455-6881* The 3/4 loop trail with bridges and boardwalks meanders through forested wetlands along the creek. There is also a children's petting farm at the park which younger children might also enjoy. Take I-405 to the SE 8th Street exit in Bellevue. Continue straight through all stop lights. Turn left on 128th Ave. SE. Turn right on SE 4th Place. The parking lot is straight ahead. Restrooms and picnic facilities are available.

Lake Hills Greenbelt 455-6855 Take the trail from Larsen Lake to Phantom Lake. The hike includes a walk through a blueberry farm, picnic areas, a created wetland, bogs, interpretive signs and a chance to see many kinds of birds. Take I-90 east from Seattle to the 148th Ave. SE exit. Go north on 148th Ave. SE. Turn right on SE 16th Street. In approximately 1/2 mile you will come upon the ranger station and interpretive center. The parking lot is just beyond the ranger station.

KIRKLAND

Forbes Creek Trail 828-1218 This forested wetland is east of Juanita Bay. Public access is at NE 106th and 108th NE.

Juanita Bay Park 828-1218 This sixty-five acre undeveloped park is composed mostly of wetlands. Features include a cattail marsh, a scrub-shrub wetland, and beaver pond. Take I-405 to the 116th Street exit. Go west on 116th to 98th Ave. NE. Turn left on 98th Ave. NE to the park entrance.

St. Edwards State Park 753-2027 Enjoy trails through forested wetlands and along the Lake Washington shoreline. Picnic areas and restrooms are available. Take I-405 to the 116th Street exit. Go west on 116th Street. Drive straight through the intersection of 98th Ave. NE and onto Juanita Drive. Go approximately 5 miles and turn left onto NE 145th Street. Look for the state park sign.

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ISSAQUAH

Beaver Lake Park *296-4171* This park is located on southwestern edge of a 62 acre lake. At the park there is a Pacific Northwest Totem pole and a picnic shelter with storyboards. A trail loops around a wetland.

REDMOND

Farrel-McWhirter Park 881-6401 The 1/2 mile loop trail follows Macey Creek through the woods. There is a children's farm, picnic area and restrooms. Take SR 520 east to Avondale Road. Turn right on Novelty Hill Road and turn right again. Turn left on Redmond Road. Continue 1/2 mile to the park entrance.

Marymoor Park 296-4232 A trail at the headwaters of the Sammamish Slough goes through scrub-shrub willow and shallow marshes. A platform overlooks the marsh at the north end of Lake Sammamish. The trails parallel Sammamish Slough riverine wetlands. Stephen Whitney's, "Nature Walks in and Around Seattle", includes detailed information and a map of this walk. From I-5 take SR520 east to West Lake Sammamish Parkway. Turn right at the light onto the Parkway. Turn left at the next light into the park entrance. Continue through the stop signs and park office. At approximately 1/2 mile turn right onto unpaved road into a parking lot. The trail starts at the south end of the lot.

SEATTLE

Foster Island 684-4075 This marsh located on the Lake Union is accessible from the Museum of History and Industry. The museum offers and interpretive brochure and map of the boardwalk nature trail.

KENT

Soos Creek Park *296-4281* A 4.5 mile trail through the park, follows the Soos Creek through cattail marshes, willow thickets, wet meadows and forested swamps. From I-5 take Orillia Road Exit and head east across Kent Valley and up to the East Hill of Kent, to the north end of the trail at Gary Grant Park. The entrance is located just east of the intersection of 132nd Ave. SE and SE 208th Ave. The trail continues south to Lake Meridian on Kent Kangley Road.

Jenkins Creek Park 296-4281 This 40 acre park includes a natural spring fed lake , prairie, upland forest and a salmon spawning creek. Take Hwy 167 to Hwy 516 exit. Head east. Road turns into Kent Kangley Road. Continue heading East on Kent Kangley Road for several miles. Turn left on Wax Road. Turn right on SE 267th immediately after Grandpa's Barbecue. Park entrance is at the end of this dead end road.

FEDERAL WAY

West Hylebos State Park 661-4041 A 1 mile boardwalk trail winds through a forested wetland abundant with bird and plant life. An interpretive description can be found in Stephen Whitney's, "Nature Walks In and Around Seattle". From I-5 take the Highway 18/S. 348th Street Exit. Head west. Go to 4th Ave. South (not 4th Place South). Turn left at signs marked dead end and Wetlands of West Hylebos.

Wetlands Resources For Educators

King County Library Materials

Prepared by Ruth Bjorklund and Franja Bryant librarians with King County Library System. Most of the books and videos listed here are available through the King County Library System.

Amsel, Sheri. A WETLAND WALK. 1993. (unpaged) Millbrook Press.
Grades K-2. This picture book describes a child's walk through a marsh in rhyming text, and introduces the plants and animals of a wetland environment.

Arnosky, Jim. COME OUT MUSKRATS. 1989. 24p. Lothrop, Lee & Shepard.
Grades K-1. Beautiful, full-page illustrations supplement a brief text which describes the activities of a family of muskrats as they enjoy their wetland home.

Back, Christine and Watts, Barrie. TADPOLE AND FROG. 1986. 24p. (Stopwatch books) Silver Burdett.
Grades 1-3. Clear, detailed photographs follow the develop-ment of a frog from egg to tadpole to frog.

Brown, Mary Barrett. WINGS ALONG THE WATERWAY. 1992. 80p. Orchard Books.
Grades 3-6. Beautifully illustrated discussion of the habitat, lifecycle, appearance and habits of twenty-one water birds from all over the United States.

Brownell, M. Barbara. BUSY BEAVERS. 1988. 32p. National Geographic Society (Books for Young Explorers).
Grades K-2. A photographic account of the life and habits of this well-known wetland animal. Includes a brief bibliography.

Caduto, Michael J and Bruchac, Joseph. KEEPERS OF THE EARTH. Native American Stories and Environmental Activities for Children. 1988. 209p. Fulcrum, Inc.
Grades 5 and up. A selection of traditional tales from many Indian peoples (including Northwest tribes). OF SPECIAL VALUE TO TEACHERS are the suggestions following each tale for related activities dealing with various aspects of the environment.

Challand, Helen J. DISAPPEARING WETLANDS. 1992. 127p. Children's Press.
Grades 5 and up. Examines the ecological role of wetlands and discusses how they are formed, what life they support, and how people modify or destroy them. "Taking Action" section describes things young people can do help preserve wetlands.

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Clarke, Barry. AMPHIBIAN. 1993. 63p. Knopf. (Eyewitness Books).
Grades 3-7. Many clear, color photographs illustrate this "Eyewitness" examination of the evolution, behaviour, physical characteristics and life cycle of amphibians the world over.

CLEARING MAGAZINE: environmental education in the Pacific Northwest. Creative Educational Networks Environmental Education Project John Inskeep Environmental Learning Center 19600 S. Molalla Ave. Oregon city, OR 97045
Grades K-12. Periodical issued six times per year offering a collection of "ideas, activities, and resources for teaching about our environment." Includes science projects, book reviews and current events. Back issues and other publications available.

Cooper, Jason. INSECT-EATING PLANTS. The Earth's Garden. 1991. 24p. Rourke Enterprises, Inc.
Grades 1-3. An introduction to insect-eating plants commonly found in wetlands. Illustrated with color photographs.

Crawford, Victoria. WETLAND PLANTS OF KING COUNTY, AND THE PUGET SOUND LOWLANDS. 1982. 80p. King County Planning Division.
A field guide targeting local wetland flora.

Dean, Jana. WETLAND TALES: a collection of stories for wetland education. 1992. 51p. Washington State Dept. of Ecology.
Grades 3 and up. Stories about wetland animals told by native peoples from around the world. Includes tips for teachers on how to use this book. A page of factual information about the animals follows each story.

Duffy, Trent. THE VANISHING WETLANDS. 1994. 159p. Franklin Watts.
Grades 7 and up. Discusses the various types of wetlands, explains their importance, and describes the plants and animals that live in them. Scattered black and white photographs and a lengthy bibliography make this useful for students.

Fleming, Denise. IN THE SMALL, SMALL POND. 1993. 32p. Holt.
Preschool-Grade 1. Bold, colorful illustrations and a rhyming text describe the activities of animals living in and near a small pond.

Greenaway, Theresa. SWAMP LIFE. 1993. 29p. Dorling Kindersley. (A Look Closer book)
Grades 3-5. Numerous color photographs illustrate this look at the plants and animals which inhabit the world's swamps.

Hester, Nigel. THE LIVING POND. 1990. 32p. Franklin Watts. (Watching Nature Series).
Grades 3-5. Describes the birds, plants, insects and other life found in ponds. Includes instructions for building a simple pond and a field guide to common pond life. habitat.

Hirschi, Ron. WHERE ARE MY SWANS, WHOOPING CRANES, AND SINGING LOONS? 1992. (unpaged). Bantam Books. (One Earth Series).
Grades 1-4. Describes the lifestyle and habitat of the swan, whooping crane, and loon and discusses how the destruction of wetlands threatens their survival. A two-page list of suggested activities is included in the back.

Hirschi, Ron. SAVE OUR WETLANDS. 1994. 63p. Delacorte Press. (One Earth Series)

Grades 5 and up. Describes 5 different types of wetland habitats and the animals associated with them. Color photographs and interesting-fact insets supplement the text.

Johnston, Ginny and Cutchins, Judy. SLIPPERY BABIES: young frogs, toads and salamanders. 1991. 40p. Morrow Junior Books.

Grades 3-6. Discusses the physical characteristics and behavior of a variety of baby amphibians as they struggle to survive and grow to maturity. Includes a glossary and a brief chapter on the future of amphibians.

Lynn, Brian. DISCOVER WETLANDS: a curriculum guide. 1988. 177p. Washington State Department of Ecology.

Grades 4-8. Extensive wetlands study program, divided into units which provide teacher background, experiments, projects and activities cross-referenced to curriculum guidelines prepared by the Office of Public Instruction.

Moon, Pat. EARTH LINES: poems for the green age. 1993. 63p. Greenwillow.

Grades 3 and up. A collection of some serious, some humorous poems celebrating the earth and reflecting a concern for its survival in an age of pollution. A fine supplement to any natural history unit.

Niering, William A. WETLANDS. 1985. 638 p. Knopf.

Audubon field guide with 600 color plates depicting wetland plants, fish, insects, and birds. Although scope is North America, northwest species are well represented.

Oxford Scientific Films. MOSQUITO. 1982. 32p. Putnam.

All grades. A photo essay on the biology and life history of the mosquito. Fascinating close-up pictures of all aspects of the mosquito's life.

Oxford Scientific Films. DRAGONFLIES. 1980. 31p. Putnam.

All grades. A photo essay on the physical characteristics and habits of the dragonfly, a common wetland insect.

Parker, Nancy Winslow and Wright, Joan Richards. FROGS, TOADS, LIZARDS, AND SALAMANDERS. 1990. 48p. Greenwillow Books.

Grades 2-5. A whole language text with large, easy-to-read print combining humor, poetry and pleasing pastel illustrations diagramming 16 examples of amphibian anatomy. Includes glossary, incex, scientific classification and range maps.

Parker, Steve. POND AND RIVER. 1988. 63p. Knopf. (Eyewitness Books).

Grades 3 and up. A close-up photographic look at the range of plants and animals found in fresh water throughout the year. Examines the living conditions and survival mechanisms of creatures dwelling at the edge of the water, on its surface, or under the mud.

Reiser, Lynn. TOMORROW ON ROCKY POND. 1993. (unpaged) Greenwillow Books.

Grades K-2. A brother and a sister anticipate tomorrow's excursion to a northern lake in this picture book. Many wetland dwellers are introduced.

Notes...

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Stone, Lynn M. POND LIFE. 1983. 45p. Children's Press.
Grades 1-3. Large print and appropriate color photos briefly describe how ponds are formed and present examples of the plant and animal life to be found.

Stone, Lynn M. WETLANDS. 1989. 48p. Rourke Enterprises.
Grades 4-6. A basic introduction of North Amercian wetlands, particulary strong in defining and clarifying terms unique to the study of wetland habitats.

Walker, Sally M. WATER UP, WATER DOWN: THE HYDROLOGIC CYCLE. 1992. 47p. Carolrhoda Books.
Grades 3-6. Easy-to-understand but in-depth scientific information about the water cycle, including human impact and historical commentary. Concepts are reinforced with frequent photos, drawings and graphs.

Weinmann, Fred. WETLAND PLANTS OF THE PACIFIC NORTHWEST. 1984. 85p. U.S. Army Corps of Engineers, Seattle District.
Text describes seven types of wetlands found in the Northwest and characterizes the most common plants among them. Color photographs and succinct description would well assist wetland field trip.

Whitney, Stephen. NATURE WALKS IN AND AROUND SEATTLE: all season exploring in parks, forests, and wetlands. 1987. 240p. Mountaineers.
Trail guide with maps and general basic information. Scope is Carkeek Park to the north, Great Blue Heron Marsh to the South, Discovery Park, West Seattle to the west and Cougar Mountain's Three Snag Loop to the east.

Williams, Terry Tempest. BETWEEN CATTAILS. 1985. 32p. Charles Scribner's Sons.
Grades 1-4. A sweeping and poetic tour of a marshland's plants and animals.

Yates, Steven A. and Noel, Sandra. ADOPTING A WETLAND: a northwest handbook. 38p. Snohomish County Planning and Community Development.
Grades 5-12. Basic book describing Northwest wetland types, plants and animals. Provides observation checklist and guidelines for developing a wetlands protection program. Contains suggestions for projects and activities.

Wetlands Videos

CATTAIL COUNTRY
Grades 2-5. Produced by Porpoise Bay Productions in association with the Canadian Broadcasting Corporation. Available from Beacon Films, 1560 Sherman Ave., Suite 100, Evanston, IL 60201. (1-800-323-9084). 28 minute video. Color. $39.95.

FABULOUS WETLANDS!
All ages. Includes 3 videos in one: Fabulous Wetlands! with Bill Nye the Science Guy. (7 minutes) Washington's Wetlands. An overview of functions and values. (15 minutes) Yellowlegs, Eelgrass and Tideflats. Natural history of estuaries. (28 minutes)
Available for $15.00 from: Washington Department of Ecology Cashiering Section P.O. Box 5128 Lacey, WA 98503-0210.

SEE HOW THEY GROW, POND ANIMALS

Grades K-3. Produced and directed by Tom Gordon. Dorling Kindersley, Inc., 1993. (See How They Grow series), 30 min. Color $14.95. Real life and animated depictions of the growth of a dragonfly, frog, duck and salamander from egg to adulthood.

Resource Agencies

King County Dept. Public Works Surface Water Managment 700 5th Ave, Suite 2200 Seattle, WA 98104 (206)296-6519

Works to control flooding, erosion, pollution and other problems caused by storm water runoff. Basin Stewards are excellent educational resources.

National Wildlife Federation 1412 16 Street NW Washington, D.C. 20036-2266 1-800-347-7829

Call to order NATURESCOPE: Wading into Wetlands, a Ranger Rick publication offering background information, activities and worksheets on a variety of wetland concepts. Grades P-7. $7.95

Puget Sound Water Quality Authority P.O. Box 40900 Olympia, WA 98504 0900 (206) 407-7300 oe 1-800-54-SOUND

Publications Department will send a publication list and PUGET SOUNDBOOK, an activity book for grades 4-7. Also provides excellent resource list for local environmental issurs.

Seattle Audubon Society 8028 35th Ave NE Seattle, WA (206)523-4483

Ask about their Wetnet program

United States Environmental Protection Agency EPA Wetlands Hotline 1-800-832-7828

Call for publications list, 9:00am - 5:30pm EST. Hotline will send free publications, or publications can be loaned out by US EPA Region 10 library.

United States Environmental Protection Agency Region 10 1200 Sixth Avenue Seattle, WA 98101 Public Information Center (206)553-1200 or 1-800-424-4EPA Library (206) 553-1289

Call Public Information Center for youth publications list and environmental videos loan list. Center also provides curriculum materials, including a thorough wetlands identi- 3 fication guide and activity poster.

Washington Native Plant Society Central Puget Sound Chapter PO Box 576 Woodinville, WA 98072-0576 (206)485-2193

Washington State Department of Ecology Shorelines and Coastal Zone Program Publications Office P.O. Box 47600 Olympia, WA 98504-7600 (206)407-7472

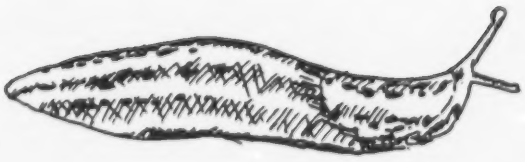
Educational materials are available free to educators. Call for publications list (they will fax) which includes children's field guide to Northwest wetland plants and animals and locally produced videos.

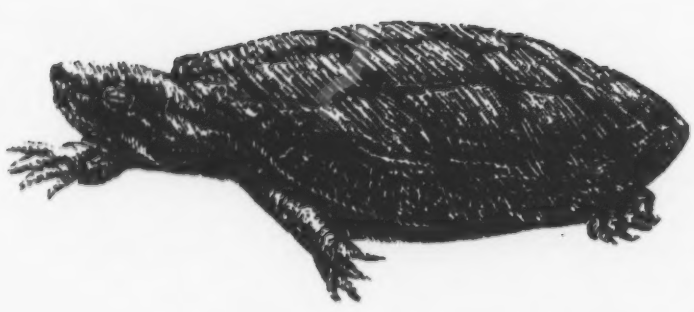
Washington State Office of Environmental Education 2545 NE 200th Street Seattle, WA 98155 (206)365-3893

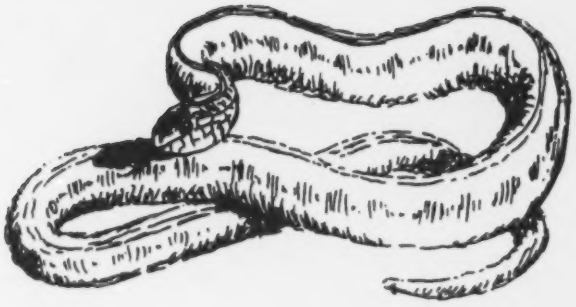
Lending library and clearinghouse for environmental education. Call for "Catalog of Environmental Education Resources" or stop in and browse the library collection.

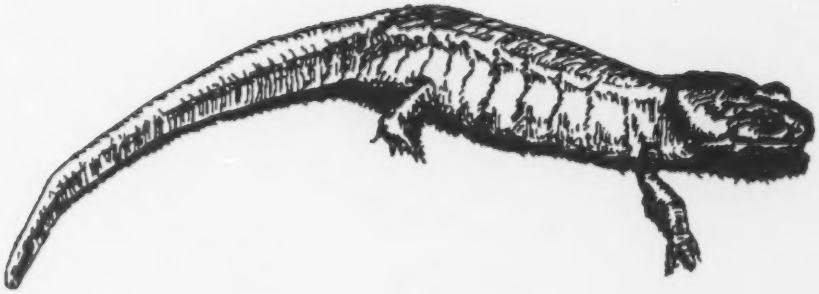
Notes...

Illustrations For Classroom Use









Glossary

anaerobic	with little or no oxygen.
amphibians	vertebrates that usually begin life in the water as tadpoles with gills that later develop into lungs; cold blooded and scaleless (ex: frogs, toads, and salamanders)
aquifers	layers of water-bearing porous rock or sediment
biological indicators	an organism that determines the health of an ecosystem.
carnivore	a flesh eating animal
carrion	the decaying flesh of a dead body, especially when regarded as food for scavenging animals
coho	a species of salmon, also known as silver
chinook	a species of salmon with spring, winter and fall runs; the spring chinook are threatened in the Puget Sound
condensation	water in the atmosphere cooling and forming water droplets.
deciduous	describes a plant that periodically (typically in autumn) loses all of its leaves
decomposer	organisms which break down organic matter to the molecular level (ex. fungi and bacteria)
detritus	dead plant, animal and other organic material
dormant	inactive or resting
drainage	the way rain water moves through a watershed off the land, and into a body of water

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ecology	the science and study of the relationships between different organisms and the environment
emergent	above
erosion	movement of soil by water and wind, often used to describe the deterioration of a stream bank or river bank from fast moving water
evaporation	water being warmed and changing from a liquid to a gas
exoskeleton	hard outside covering of insects
evergreen	trees that do not lose their leaves in the fall
faculative	plants found in wetlands at least 33% of the time
fen	unlike bogs, have slow moving water which rinses out the acid created by peat and mosses
flood	when streams and rivers overflow their banks
gleying	wetland soil that is gray, green or blue in color
groundwater	water found under the ground in zones of soil and bedrock
habitat	plants, waters and soils that provide and organism's needs for food, water, and shelter
hydric soil	soil that is wet long enough during the growing season (at least one week) that the soil begins to change and take on new characteristics
hydrophytes	plants that can grow without much oxygen
impervious surface	a surface such as concrete or blacktop that can not be penetrated by water, keeps the water from seeping into the ground

infiltration	water moving between particles of soil, sand, gravel and clay or through fractures in rock
invertebrate	an animal without backbone or spinal column (ex. insects, worms, mollusks, spiders, crustaceans)
king	a species of salmon otherwise known as tyee
larvae	the immature form of certain insects during which it differs from its adult form
metamorphosis	(complete) a change in the form of a living thing as it matures from egg, larva, pupa and adult
metamorphosis	(incomplete) a nymph undergoes a series of gradual changes until it becomes an adult
mottling	small blotches of yellow to reddish-brown concentration of iron and manganese found in wetland soil
nymph	the immature form of certain insects whose histories are characterized by incomplete metamorphosis some are also known as naiads
obligates	plants found in wetlands at least 99% of the time
omnivore	an organism that feeds on both animal and vegetable matter
peat	mat made up of rotting plants and animals
predator	an animal that actively hunts and kills its food
pupa	the inactive stage in the metamorphosis of many insects
rain	water condensed from atmospheric vapor, falling to earth in drops
salmon	a fish known throughout the world for its flavorful edibility and unique life cycle

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scavenger	an animal which feeds of carrion
silt	tiny, fine particles, such as soil or sand, suspended in and deposited by water; too much of this can suffocate salmon eggs
spawning	when a fish deposits its eggs on the stream bed
stream	a narrow body of water
submergent	below
succession	the gradual replacement of one community by another
surface water	water from rain or melting snow that runs across the surface of the earth
vertebrates	animals characterized by a segmented spinal column and a brain enclosed with a cranium (ex. mammals, fish, birds, reptiles and amphibians)
watershed	the land from which rain collects and runs to a single point; also called a basin
watertable	the surface in a permeable body of rock of a zone saturated with water
wetland	a lowland area, sometimes soggy, with plants well adapted to living in wet conditions

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